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An Investigation of the Etiology and Pathogeny of Equine Chronic Arthritis (Rheumatoid Arthritis).

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Foreword.

It was in an atmosphere of good-natured discussion upon a colleague's study of rheumatoid arthritis in man that the hope of finding some help from a comparative study was born. A number of specimens of chronic equine arthritis from the Pathological Museum of the University of Liverpool was found to resemble those of the human disease; so, having premised that these equine lesions were attributable to an infectious factor, it was decided in October, 1924, with the approval and every assistance of Professor E. E. Glynn, that the author should conduct a bacteriological and histological examination of the affection in a series of equine patients.

The absence of any such comparative investigation from the literature available for consultation made it all the more necessary that precise definitions of the research should be formulated. As the work of Adams[1] (1857), Charcot[14] (1877) and the bacteriologists of the nineties had defined specific types of human arthritis, so veterinary investigators had isolated the analagous arthritides of animals. Thus it was possible to exclude arthritis due to (1) any of the known specific organisms, *e.g.*, streptococci, T.B.; (2) local injury, *e.g.*, fractures and dislocations; (3) neoplasms; (4) any known metabolic disease, *e.g.*, gout, rickets; (5) any known disease of the nervous system, or (6) senility.

There remained, both in man and horses, a disease of the joints of unknown origin, but characterised by a tendency to chronicity. As a general rule, this arthritis of the horse has been studied upon the regional or anatomical concept of the humoral pathologists, *viz.*: Shoulder joint arthritis by Canton[13] (1862). Carpal arthritis by Cherry[15] (1845), Schrader[55] (1860) and Kruger[43] (1906). Articular ringbone by Udriski[62] (1900), Karnbach[41] (1900) and Hunting[35] (1908). Navicular disease by Smith[56] (1886). Suffraginitis by Hunting[38] (1912) and Bretschneider[8] (1910). Stifle joint arthritis by Hohne[31] (1892), Zalewsky[66] (1901) and Hunting[37] (1912). Spavin by Eberlein[19] (1897), Cadeac[11] (1908) and Goldberg[28] (1918). Temporo-maxillary joint arthritis by Samodjelkin[54] (1912).

There may be many sound reasons why the regional classification has been maintained, in spite of the notion amongst the mid-nineteenth century veterinarians of an "osteitic diathesis" distinguishing this arthritis, yet it is sad to reflect that more attention has not been paid by veterinary science to this early concept and its interpretations by subsequent authors. For instance, Hohne[31] (1892) gave a detailed account of the changes in the stifle joint found in spavined horses, and concluded that spavin arose secondarily to a chronic gonitis. Smith[56] (1893) classified ringbone and spavin, also navicular disease, as "specific joint diseases" in which "there is something in common in the nature of the lesions produced which would lead one to suspect that the changes occurring in each are closely allied." Hunting[36] (1911) recognised the close resemblance of the lesions of spavin, suffraginitis, ringbone and navicular disease, to which list in 1912 he added the chronic arthritis of the stifle joint. Kruger[43] (1906) and Bretschneider[8] (1910) have recorded similar observations.

To some medical investigators of this arthritis of unknown etiology, the terms rheumatoid and osteo-arthritis are synonymous; to others who follow the work of Garrod[26] (1876) they represent two distinct types. One author will point to the variable etiology of osteo-arthritis, another will preserve its specific identity as the chronic stage of rheumatoid arthritis; yet other writers prefer to consider the disease in all its manifestations under such labels as arthritis deformans, chronic non-infectious, and chronic non-tuberculous arthritis. Then, accordingly as the concept of the investigator is that of the clinician or pathologist, the classification varies as between degenerative, proliferative, atrophic, deforming, monoarticular, polyarticular and other types. This is all very perplexing to the investigator who is seeking for common ground upon which a definition can be established, for he finds that these typings, groupings and christenings are assumptions for the convenience of description. It is far easier to define what this arthritis is not, than to provide a positive definition which would find universal acceptance.

Thus it happened that the author set out on his investigation with no further definition than *a disease of joints tending to chronicity, which was probably specific but due to no known specific cause*, and for which he utilised the term in veterinary literature of "chronic arthritis." Confidence in the value of this broad concept came to the author on his reading in a discussion upon rheumatoid arthritis (1925) that Timbrell Fisher[25], whose series of publications have proved of the greatest inspiration to this work, had suggested that "the term 'chronic arthritis' is simple and accurate and embraces all the pathological types; it allows also for expansion."

Technique.

A. Of the Ante-Mortem Examination.

In response to the request for assistance, certain Liverpool veterinary surgeons very kindly advised the author of their chronic arthritic cases which had been cast for slaughter. These, together with the horses otherwise purchased by a firm of horse slaughterers, formed the material for this study. It was decided that an adequate number of controls was a necessary feature of the study, so arrangement was made to examine the horses in the order of slaughter as suited the convenience of the master-butcher. Visits to the slaughterhouse extended over a period of approximately eighteen months, and at each visit an average of three horses was examined *ante*-and *post-mortem*, with a total of 146 horses in all.

The following procedure was adopted. The horse awaiting slaughter was first submitted to a physical examination in its stall; it was then walked, backed, turned, and, if time permitted, trotted in the yard. Any abnormalities were recorded, with the diagnosis arrived at. It is here emphasised that this *ante-mortem* examination was made as a guide to subsequent procedure, and not as a clinical study of lameness. Subsequent to the *post-mortem* examination the histories of the animals deemed positive cases were sought either from the veterinary surgeon or from the former owner. (See Appendix of Case Records.)

B. Of the Post-Mortem Examination.

The animal showing clinical evidence of chronic arthritis was destroyed with the humane killer, and its throat cut. The hair was removed from an area of approximately two inches radius from the site of puncture of the joint or joints chosen for examination; alcohol, 98 per cent., was freely applied and the area flamed. (N.B. After four cases it was deemed advisable, for the avoidance of contamination, to limit the procedure to one joint.) The charred area was scraped clean with a scalpel and a second dressing of alcohol applied and lighted. While the spirit was burning, the

skin, subcutaneous fascia and outer layer of the joint capsule were penetrated by the thermo-cautery needle, and through this puncture a fine trocar and cannula were inserted, the synovial layer pierced and the joint cavity entered. The trocar was withdrawn and the exposed end of the cannula flamed. A 20 c.c. glass syringe was fitted to the cannula, and the fluid contents were withdrawn and their volume recorded. The synovia was expressed (1) 0.5 c.c. into each of two tubes of serum broth, (2) approximately 5 c.cs. into each of two empty sterile test-tubes to serve as ærobic and anærobic controls, (3) the remainder, if any, into a wide sterile test-tube for cytological and/or chemical examination. (N.B. The chemical estimation of the synovial fluids and their interpretation are not as yet completed, and will form the subject of an early publication in collaboration with Dr. Henry Cohen.)

Upon the withdrawal of the fluid, the area was flamed a third time, and while alight, a cruciform incision centred upon the cannula, which remained as a director, was made through each layer of tissue until the synovial lining was exposed. The synovial lining was then grasped with Spencer-Wells forceps and two pieces of it and the adjacent portion of the capsule, each of the size of a bean, were excised with scissors, passed rapidly two or three times through the flame of a spirit lamp, and inserted, each piece, into a separate tube of serum broth.

The lips of the incision were now grasped with Spencer-Wells forceps to expose the intra-articular portions of one of the bones. A steel drill was inserted into the bone for a depth of approximately 1½ins. and then withdrawn. The cartilage and bony shavings removed within the groove of the drill were divided between two tubes of serum broth. This last operation was attended with great difficulty, as it was not always possible to avoid clogging with a piece of loose synovial lining or loosing the shavings off the drill, so that only fourteen samples were taken with satisfaction to the author.

The carcase was now dressed by butchers in the usual way, and the organs as exposed or excised were examined macroscopically for abnormalities. The limbs as excised at the carpal and tarsal joints were dissected, and the joint and tendon fluids and structures examined. Any specimen of interest was removed to the laboratory for more detailed dissection. Thus all the organs and joints of the body, including the brain and spinal cord, came under view, with the exception of the shoulder, elbow, hip and stifle joints.

Cases Nos. 1 and 4 were exceptions to the above in that, as the carcases were not required for meat, all joints of the body were exposed for examination.

All instruments, excepting the thermo-cautery, utilised in obtaining the specimens for bacteriological examination were sterilised by boiling immediately before use.

C. Of the Bacteriological Examination.

Primary cultures consisted of two samples of each of the three joint tissues, *viz.*, (1) synovial fluid, (2) capsule with its synovial lining, (3) cancellous bone and its marrow, introduced at the time and place of slaughter into tubes of beef broth to which 5 per cent. horse serum had been added. One set of three was incubated ærobically and the second set anærobically (in Buchner's jars) at 37°C. Anærobiosis was controlled with the methylene blue process of McIntosh and Fildes. The cultures were examined by (a) the hanging-drop method, (b) films stained by Gram's method, the ærobic after 24 hours, the anærobic after five days' incubation. In the absence of growth the ærobic tubes were incubated for a further six days. At the time of examination, subcultures were made on to serum-nasgar and MacConkey plates, and these were examined after 48 hours' incubation (ærobically and anærobically) at 37°C. These plates were examined with the aid of Zeiss prismatic binoculars, and films stained by Gram were made of each type of colony. Colonies of staphylococci or *B. subtilis*-like organisms were not examined further, otherwise the following procedure in the identification of the colonies was observed.

A. Streptococcal colonies.—The colonies were "fished" with a platinum spud into 5 per cent. serum broth, whence, after 48 hours incubation at 37°C., tubes of serum-sugar-peptone water were inoculated. (The serum-sugar-peptone water media consisted of 1 per cent. lactose, mannite, or salicin in peptone broth to which 5 per cent. horse-serum and 1 per cent. Andrade's indicator were added, and the whole neutralised to a p. H. of 7.6 to 7.8.) The sugar tubes were incubated at 37°C. for seven days, and the daily changes of the indicator were recorded.

The hæmolytic capacity of the organisms was tested by mixing 10 drops of a 10 per cent. suspension of washed human red blood corpuscles in 0.85 per cent. NaCl to 10 drops of a 24 hour serum broth culture of the organisms, using Dreyer's tubes. A control tube of washed red blood corpuscle emulsion and serum broth was also prepared. The tubes were incubated in a water bath at 37°C. for one hour.

The bile-solubility test was performed by mixing within a Dreyer's tube five drops of a 24 hour serum broth culture, three drops of 0.85 per cent. NaCl, and two drops of cleared ox-bile. A control tube contained five drops of 0.85 per cent. NaCl and five drops of the broth culture. The tubes were incubated in a water-bath at 37°C. for one hour.

B. Diphtheroid colonies.—The same procedure as for streptococci was followed, save that the additional "sugar" media consisted of 1 per cent. glucose, maltose or saccharose in peptone water, neutralised to +10 to phenolphthalein, with litmus as indicator.

C. Coliform colonies.—The colonies were sub-cultivated in a series of 1 per cent. peptone-water-carbohydrates neutralised to +10 to phenolphthalein with litmus as indicator. Litmus milk and peptone water were also inoculated, the latter after 48 hours incubation being tested for motility and for indol production.

Controls.—The following controls of the primary cultures were set up—(1) After inoculation of the two serum-broth tubes each with 0.5 c.cs. of synovial fluid, the balance of the fluid was expressed into an empty sterile tube. If the amount permitted, 8-10 c.cs. of the fluid was divided between two sterile tubes, one for ærobic the other for anærobic cultivation; (only one ærobic control was established in specimens Nos. 3a and 12, while the balance of No. 12 was lost through breakage). The presence of organisms was observed by the naked eye appearance and by Gram stained films. The tubes in which no growth was obtained were returned to the incubator for seven days before giving a final decision as to the presence or absence of organisms.

(2). Two tubes of uninoculated serum broth were incubated, one ærobically and the second anærobically alongside the primary cultures of each individual case as a control on the medium.

(3). During the course of the investigation additional controls were made by cultivating the joint structures of three normal horses, using the technique as applied to the arthritic cases. These animals were clinically healthy city cart-horses slaughtered for meat and were found on *post-mortem* examination to be free from macroscopic abnormalities.

D. Of the Histological Examination.

As soon as any one limb had been dressed by the butcher, the joints were dissected while warm, and samples of the articular lesions were removed and at once dropped into pots containing "buffered" formalin. After 48 hours fixation, suitable pieces of the soft tissue were cut with a razor, passed through the graded alcohols, cedar-wood oil, and chloroform, and finally embedded in paraffin.

Pieces of the capsule which had been incubated in serum-broth were fixed in buffered formalin for 48 hours and then passed through the above process.

Sections about 1-2 m.ms. thick, of bone and articular cartilage, osteophytes or ossified capsule, were cut away from the joint by means of a fretsaw, fixed over-night in buffered formalin, and then transferred to decalcifying fluid. Subsequent to decalcification these specimens were

passed through the same process as the soft tissues save that upon introduction into the hot paraffin they were placed in the vacuum-oven so as to ensure a better penetration of the tissues by the paraffin. Jenkins' decalcifying fluid[40] (1921) was found to give the most reliable results.

Sections were cut upon the microtone at 1-2 micra thick, and stained by the hæmatoxylin and eosin, Weigert's and Van Gieson's methods, while Gram's and Ziehl Neelsen's carbol fuchsin methods of staining were utilised in the search for organisms.

E. Of the Cytological Examination of the Synovial Fluid.

The technique as planned involved the transport of the synovial fluid to the laboratory, where it was centrifuged for 20 minutes at 3,000 revs. per minute. The deposit was then washed in two changes of 0.85 per cent. NaCl. From the washed deposit films as for blood were made and stained with Leishman. The balance of the deposit was fixed by adding buffered formalin to the tube, and after 48 hours was passed through the alcohols, embedded in paraffin and cut as for histological specimens. The sections of the deposit were stained with hæmotoxylin and eosin.

On the whole a series of most unsatisfactory results were obtained. In the first place, it was found that within one hour, or at the most two hours, from the time of its withdrawal, the synovial fluid had clotted. If left standing, very gradual shrinkage of the faintly opaque, jelly-like clot occurred as it remained suspended within a yellow liquid, a larger volume of the liquid being beneath than above the clot. Breaking up this clot before centrifuging was tried but the results were of no value.

Then the films made from the deposit appeared hazy, and the structure of the cells was indistinct. The stains were at first held responsible but were found to be very satisfactory when utilised for staining blood films. Attempts were then made to remove the "glairy substance" (probably the nucleo-protein content of the fluid) by washing the film previous to applying the stain. The films were washed in varying strengths of acid alcohols, then alkali alcohols and finally simple alcohols were used with no improvement.

Towards the end of the investigation it was found that clotting of the synovial fluid did not occur if transported to the laboratory in the unopened joint. Unfortunately this procedure precluded (1) the preparation of cultures of the fluid, and (2) any estimation of the condition of the joint structures until the laboratory was reached. Certain of the difficulties encountered are described because none of the literature consulted provided any guidance to the examination of synovial fluid.

Results.

A. Of the General Examination.

This investigation has entailed the *ante* and *post-mortem* examination of 146 horses upon the day of their slaughter. Of these, 21 (14 per cent.) were affected with the chronic arthritis as defined in the foreword. Four of the horses were lame from other pathological conditions of the limbs, while the remaining 121 revealed no *ante-mortem* and, assuming that their undissected shoulder, elbow, hip and stifle joints were not affected, no *post-mortem* evidence of chronic arthritis. Burt[10] (1913) recorded that "in every eight horses that come to be slaughtered in London one has been found to suffer from cab-horse disease" (suffraginitis). Dollar[17] quotes Lungwitz as having found 14 per cent. of 1,251 horses affected with "sidebone," while Zimmerman[68] (1909) out of 1,000 horses found upon clinical examination alone 33 per cent. affected with the same condition. Upon these *data* it would appear that *approximately 15 per cent. of horses at the time of slaughter show evidence of chronic disease of the bones and joints.* A summary of the joints affected in each patient is presented in Table No. 1. With the exception of Cases Nos. 1 and 4, the shoulder, elbow, hip and stifle joints were not available for dissection. Of those examined, 70 per cent. of the tibio-astragaloid joints, 24 per cent. of the carpal joints, 21 per cent. of the fetlock joints and 4 per cent. of the phalangeal joints were affected.

As shown in Table No. 2, the diseased joints on an average contained three times more synovial fluid than the normal. The increase of fluid in chronic arthritis joints is frequently recorded both in medical and veterinary literature, but no mention has been found of any measurements being taken at any stage of the disease for comparison with the normal. Upon osteo-arthritis, Fisher[22] (1922) writes: "The presence of fluid may not infrequently be detected; and in certain cases fluid may be present in marked quantity, not only in the joint itself, but in bursæ communicating therewith, and occasionally in bursæ and tendon-sheaths quite unconnected with the joint cavity." These latter observations contain an advance upon previous records in that the clinical changes within the tendon-sheaths are associated with those in the joints. The synovial fluid content of the affected sheaths in nine cases of this series varied from a 2 c.c. addition to the normal volume to the considerable amount, *viz.*, 330 c.cs., withdrawn from the sheath of the flexor perforans in Case No. 16. *Thus the volume of synovial fluid both in the joints and tendon-sheaths affected with the chronic arthritic process has a decided tendency to increase.*

The ages of the animals at the time of slaughter varied between 6 and 28 years, with an average of 16 years. Goldberg[28] (1918) gives details of seven horses affected with chronic arthritis, of which three have an average age of 16 years, the remainder being described as "aged." Porch and Hunting[49] (1908) described the morbid changes in two mares, one seven years old, the other eight years old, affected with chronic arthritis of the stifle joint, and a similar case in a horse of about eight years is described by Wooldridge[65] (1908). Thus in the majority of cases chronic arthritis of horses is a crippling affection by the advent of middle age. The greatest difficulty was experienced in tracing back to the onset of the affection, as so few owners had any precise recollections of the initial signs of disorder. Only Cases Nos. 3, 4, 14, 16 and 29 provided any assistance. These five horses varied in age at the time of slaughter between 6 and 16 years with an average of 11 years; and their ages at the clinical onset varied between 5 and 11 years with an average of 8 years. Case No. 6 is an exception in that the animal revealed advanced lesions at the age of 6 years. A horse attains its full growth at about its sixth year, thus these few records point to *chronic arthritis as a disease of maturity*, which may in a minority of cases arise in adolescence.

The association of septic foci with many cases of chronic arthritis in man prompted the author to make a diligent search for such foci in the 21 arthritic horses; but of these only three revealed macroscopic pathological changes in their viscera —*viz.*, a chronic gastritis due to Gastrophilus larvæ (No. 11), cystic ovaries (No. 16), and a recent broncho-pneumonia (No. 25).

B. Of the Cytological Examination of the Synovial Fluid.

Though, as detailed under Technique (Section E), the examination of the synovial fluid was accompanied by so many obstacles, yet it has been found possible to accumulate a few observations from Cases Nos. 3, 4 and 12. Two tubes of one sample from each of these three cases were centrifuged before clotting had occurred. At the bottom of the centrifuged tube in each case was a small mucus-like deposit which, with the aid of a prismatic lens, was seen to be divided from the supernatant yellow fluid by a whitish opaque film. The deposit contained delicate shreds of tissue and dark particles. The approximate volume of these contents in the tube were supernatant fluid; deposit as 20 : 1, the dividing opaque film being no thicker than a postage stamp.

Paraffin sections of the deposit stained with hæmatoxylin and eosin revealed three distinct varieties of cells:—

1. A round or oval-shaped cell containing a deep purple spherical or oval nucleus surrounded by an eosinophilic non-granular cytoplasm. In some of the

TABLE No. 1. OF THE TYPE OF HORSE AND THE JOINTS AFFECTED WITH CHRONIC ARTHRITIS.

Case No.	Type of Horse				Joints of Limbs Affected																				Associated Skeletal Changes			
					Left Fore Limb						Right Fore Limb						Left Hind Limb						Right Hind Limb								
	Breed	Sex	Age	Work	S	E	C	F	P1	P2	S	E	C	F	P1	P2	H	St	Hk	F	P1	P2	H	St	Hk	F	P1	P2	Spondylitis Deformans	Ringbone	Sidebone	Splints
1	Cart	G	18	Farm	o	x	x	o	o	o	x	o	x	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o		x	x	
3	Shire	G	16	City									x	x	x	o														x		
4	Shire	G	12	City	o	x	o	o	o	o	x	o	o	o	o	o	o	x	x	x	o	o	o	o	o	x	o	o				
5	Shire	G	6	Farm			o	o	o	o			o	o	o	o			x	o	o	o			x	o	o	o				
7	Cart	F	10	City			o	o	o	o			o	o	o	o			o	o	o	o			x	x	o	o				
11	Shire	G	16	City			o	x	x	x			x	x	x	x			x	x	x	o			x	o	o	o		x	x	x
12	Pony	F	18	City			o	o	o	o			o	o	o	o			o	o	o	o			x	o	o	o				
14	Shire	G	9	City			o	o	o	o			o	x	o	o			x	o	o	o			x	o	o	o				x
16	Cart	F	10	City			o	o	o	o			o	o	o	o			o	o	o	o			x	o	o	o				
17	Cart	G	20	?			x	o	o	o			x	o	o	o			o	o	o	o			o	o	o	o				
18	Pony	F	25	?			o	o	o	o			o	o	o	o			o	x	o	o			x	x	o	o				
19	Vanr.	F	15	City			o	o	o	o			o	o	o	o			x	o	o	o			x	x	o	o				
22	Cart	F	25	?			x	o	o	o			x	o	o	o			o	o	o	o			o	o	o	o	x			
23	Shire	G	17	?			o	o	o	o			o	o	o	o			x	o	o	o			x	o	o	o	x			x
25	Shire	G	9	Farm			o	o	o	o			o	o	o	o			x	o	o	o			x	o	o	o				
26	Pony	G	20	City			o	o	o	o			o	o	o	o			o	o	o	o			x	x	o	o				
29	Shire	F	6	City			o	o	o	o			o	o	o	o			x	o	o	o			x	o	o	o				
31	Vanr.	G	28	City			o	o	o	o			o	o	o	o			x	x	o	o			x	x	o	o				
32	Shire	F	20	?			o	x	o	o			o	o	o	o			x	o	o	o			x	o	o	o				
33	Shire	F	18	City			o	o	o	o			x	x	o	o			x	o	o	o			x	o	o	o				
34	Shire	F	18	City			o	o	o	o			x	o	o	o			x	x	o	o			x	o	o	o		x		

N.B. G = Gelding; F = Female; S = Shoulder; E = Elbow; C = Carpus; F = Fetlock; P = Phalangeal; H = Hip; St = Stifle; Hk = Hock. Presence of lesions is indicated by x. Joints not examined are left blank.

TABLE No. 2.—OF THE SYNOVIAL FLUID CONTENT OF NORMAL AND CHRONIC ARTHRITIC JOINTS. (In c.cs.)

A.—Chronic Arthritis Series.				B.—Ten Normal Horses.			
Case No.	R. or L. T.-A.	R. or L. Mc.-P.	R. or L. Mt.-P.	Case No.	R. or L. T.-A.	R. or L. Mc.-P.	R. or L. Mt.-P.
1	—	—	—	1	—	{2·0 {6·0	—
3	—	7·0	—	2	—	6·5	—
4	14·0	—	13·5	3	12·5	—	2·5
5	33·0	—	—	4	5·5	—	—
7	36·0	—	—	5	7·5	—	—
11	—	13·0	—	6	—	—	2·5
12	8·5	—	—	7	—	—	2·5
14	{11·0 {12·5	—	—	8	{13·0 {11·5	—	—
16	25·5	—	—	9	10·0	—	—
17	—	—	—	10	{11·5 {13·0	—	—
18	—	—	14·0				
19	42·0	—	—				
22	—	—	—				
23	—	—	—				
25	48·0	—	—				
26	5·0	—	—				
29	42·0	—	—				
31	27·0	—	—				
32	23·5	—	—				
33	{21·0 {17·0	—	—				
34	23·0	—	—				
Average content per joint	32·5 ccs.	11·9 ccs.		Average content per joint	10·6 ccs.	3·7 ccs.	

N.B. T-A = Tibio-astragaloid; Mc.-P. = Metacarpo-phalangeal; Mt.-P. = Metatarso-phalangeal.

typical cells the smooth-contoured nuclei were central, in others they were eccentric. The average measurements of 25 typical cells gave a cell of 6μ with a nucleus of 3μ. On comparison with the histological sections, the cells of this group corresponded in measurement and structure with those found lining, and scattered within, the villi undergoing hyperplasia, as well as with those cells found on the surface of the synovial lining of normal joints.

2. This was a lymphocyte-like cell containing a large spherical purple nucleus surrounded by a thin rim of clear eosinophylic cytoplasm, which was only seen in that part of the section corresponding to the macroscopic opaque film. This cell on the average measured 6μ, with a nucleus of 4μ.

3. A comparatively small proportion of apparently healthy red blood corpuscles.

The sections also revealed the presence of a considerable amount of pigment granules, some connective tissue fibrils, and shreds of a pink-staining homogeneous structure resembling cartilage matrix.

In some of the Leishman films of the mixed deposit it was possible to distinguish certain additional features. In their fresh state all the cells upon the films were very much larger than those in the paraffin sections. Here again the predominant type of cell corresponded with the first described above, and revealed a finely reticulated nucleus. The majority of these cells were undergoing various stages of dissolution, in the latter stages of which the nuclei were represented as single masses of purple granules. The occasional cell of the second type observed in the film corresponded in every way to the small lymphocyte as seen in the normal blood film. Again the red blood corpuscles appeared perfectly healthy, and were dotted about either singly or in rouleaux of 3 to 8 cells. They averaged one to three of the first type of cell.

In his endeavours to overcome the technical difficulties, the author has experimented with a dozen synovial fluids from normal joints. In two of these the films presented similar pictures to those of the pathological samples, also there was no consistent macroscopic difference in the centrifuged fluids.

Summary of Cytological Findings.

The synovial fluid from three cases of chronic arthritis contained "synovial" cells, lymphocytes, red blood corpuscles, connective tissue fibrils, shreds of cartilage matrix and pigment granules. These elements were also found in the control synovial fluids of normal horses.

The "synovial" cells corresponded with the cells of proliferating villi in arthritic joints, and with those of the synovial lining in normal joints. The presence of shreds of cartilage matrix suggests that some of these cells were free cartilage cells.

The proportion of lymphocytes to red blood corpuscles was approximately that of blood. They showed no evidence of degeneration and were found in the normal fluids. In spite of the absence of leucocytes, the findings suggest *ante-mortem* leakage of minute quantities of blood into the joint cavity.

C. Of the Bacteriological Examination.

The principal results of the bacteriological study are recorded in Table No. 3. From twenty chronic arthritic patients the following numbers of samples were studied: 26 of the synovial fluid, 16 of the capsule and its synovial lining and 11 of the cancellous bone and its marrow, and each was duplicated for ærobic and anærobic cultivation.

(*a*) *Streptococci.* (Tables Nos. 3 and 4).

(1). *Classification.*—It was decided to adopt Holman's classification[32] (1916). Holman divided the streptococci into two primary groups (the hæmolytic and the non-hæmolytic), each of which was sub-divided into eight sub-groups according to lactose, mannite and salicin reactions.

(2). *Morphology.*—Pleomorphism was a constant feature of all the streptococcal primary cultures, appearing in hanging drops and films as (Gram positive) single, diplococcal, long and short-chain forms. Upon further sub-culturing through serum broth the long-chain forms preponderated. Upon occasional films, though no capsule stains were employed, definitely capsulated forms were found.

Culture.—On nasgar the colonies appeared after 48 hours incubation as isolated, semi-transparent, domelike, non-nucleated pin-heads with regular edges. In stab-gelatin tubes minute, spherical, whitish colonies developed after ten days along the needle track, and showed no tendency to invade the surrounding medium. There was no liquefaction. In serum broth the streptococci formed a flocculent deposit with a clear supernatant fluid.

Further Tests.—The streptococci proved facultative anærobes, growing equally well under either condition. They were non-hæmolytic and non-bile-soluble. The growths in "sugar" media identified the organisms from Case No. 3 as Streptococcus fæcalis (Holman) and from Case No. 4 as Streptococcus equinus (Holman).

(*b*) *Diphtheroids.* (Tables Nos. 3 and 5).

(1). *Classification.*—By a slight modification of Hewlett's scheme[30] (1921) an attempt was made to identify the members of this group, but no consistent results were obtained.

(2). *Morphology.*—All of these Gram positive bacilli classed as diphtheroids revealed many pleomorphic forms in primary broth cultures, appearing as large spherical forms, rods with clubbed extremities and occasionally branched forms, in addition to the more common form of delicate, non-motile rods showing granular staining. The latter property was especially evident with methylene blue; but the characteristic granular staining of *B. diphtheriæ* with Neisser's stain was not obtained.

Culture.—On nasgar plates after 48 hours, variations in the colonies, not only of the organisms from different cases but also of the same organism in each case, were observed. The colonies appeared as pin-head, raised, smooth-edged surface growths. The faintly-opaque colonies were characterised by a definite granular nucleus, while at the other end of the scale non-nucleated but markedly opaque colonies with a yellow tinge were seen. Variations in serum broth cultures were also noted, from a granular deposit with clear supernatant medium to a yellowish deposit with slight turbidity.

Further Tests.—The organisms grew equally well under ærobic and anærobic conditions. All proved non-hæmolytic and non-bile-soluble. By means of the "sugar series" three different types of the group were isolated from separate cases. Two c.cs. of a luxuriant 48 hour serum broth culture of the organisms from Case No. 17, were injected intraperitoneally into a guinea-pig, with no results.

(*c*) *Staphylococci.* (Table No. 3).

Staphylococci were isolated from ten specimens removed from eight arthritic cases and from four specimens in two control animals. Only in four specimens were pure cultures obtained.

Observations upon this group were confined to the morphology in Gram stained films and growth upon nasgar and MacConkey plates, in gelatin tubes and within serum broth. In all cases a similar organism was obtained, *viz.*, a Gram positive spherical coccus producing porcelain-white shining colonies on nasgar, and fermenting lactose with reduction of neutral red on MacConkey plates, with liquefaction and the liberation of a white pigment in gelatin. Upon comparing the observations with Andrew's and Gordon's[2] (1905) classification the organisms isolated were found to be indistinguishable from staphylococcus epidermidis albus.

(*d*) *Coliform Organisms.* (Tables Nos. 3 and 6).

Morphology.—Gram negative short oval rods predominated, long filamentous, also short oval rod forms were encountered in all samples. Feeble motility was seen in two of the six samples.

Culture.—The spreading surface growth characteristic of the Colon-Typhoid group, with fermentation of lactose and liberation of neutral red on MacConkey plates, was

TABLE No. 3.—OF THE BACTERIOLOGICAL EXAMINATION OF TWENTY CASES OF CHRONIC ARTHRITIS AND OF THREE NORMAL HORSES.

Case No.	Joint	Synovial Fluid. Ærobic	Synovial Fluid. Anærobic	Controls	Capsule and Synovial Lining. Ærobic	Capsule and Synovial Lining. Anærobic	Cancellous Bone. Ærobic	Cancellous Bone. Anærobic	Bone Utilised
3	R.C.	Strep. Staph. *B. coli.*	Strep.& Staph. *B. coli.*	X	Strep.	Strep.& Staph.	—	—	—
3A	R. Mc.-P.	O	O	O	Strep.& Staph.	Staph. & *B. coli.*	—	—	—
3B	R. F.-I.	—	—	—	*B. proteus*	*B. proteus*	*B. coli.*	*B. coli.*	Os Suffraginis
4	L. Mc.-P.	Strep. & Diph.	Strep. & Diph.	X	Strep.	Strep.	—	—	—
4A	R. Mc.-P.	Diph.	Diph.	X	—	—	O	O	Metacarpus
4B	L. T.-A.	O	O	O	S.-r.	S.-r.	O	O	Astragalus
4C	L. Mt.-P.	O	O	O	Strep.	Strep.	—	—	—
5	L. T.-A.	O	O	O	—	—	—	—	—
7	R. T.-A.	Staph.	O	O	—	—	—	—	—
11	L. Mc.-P.	O	O	O	Staph.& Diph.	Staph. & Diph.	—	—	—
12	L. Mc.-P.	Staph.	Staph.	X	—	—	—	—	—
12A	R. T.-A.	O	O	O	—	—	—	—	—
14	R. Mc.-P.	—	—	—	*B. coli.*	*B. coli.*	—	—	—
14A	L. T.-A.	O	O	O	—	—	—	—	—
14B	R. T.-A.	O	O	O	—	—	—	—	—
16	R. T.-A.	O	O	O	—	—	—	—	—
17	L. C.	Staph.	Staph.	X	—	—	Diph.	Diph.	Radius
18	R. Mt.-P.	O	O	O	*B. coli.*	*B. coli.*	O	O	Metatarsus
19	R. T.-A.	S.-r.	S.-r.	X	*B. coli* & S.-r.	*B. coli.* & S.-r.	O	O	Astragalus
22	R. T.-A.	O	O	O	—	—	—	—	—
23	L. T.-A.	O	O	O	O	O	O	O	Astragalus
25	L. T.-A.	O	O	O	O	O	O	O	Astragalus
26	R. T.-A.	O	O	O	—	—	—	—	—
29	R. T.-A.	O	S.-r.	O	O	*B. coli.*	Staph. & Diph.	Staph. & Diph.	Astragalus
31	R. T.-A.	O	O	O	O	O	—	—	—
32	R. T.-A.	Staph. & *B.coli.*	Staph. & *B.coli.*	X	—	—	—	—	—
33	L. T.-A.	O	O	O	O	O	O	O	Astragalus
34	L. T.-A.	O	O	O	O	Staph.	O	O	Astragalus
Controls.									
A	L. T.-A.	O	O	O	Staph.& *B.coli.*	Staph.& *B.coli.*	O	O	Astragalus
B	L. T.-A.	O	O	O	O	O	O	O	Astragalus
C	R. T.-A	Staph.	Staph.	X	Staph.	Staph.	Staph.	Staph.	Astragalus

N.B. R =Right ; L =Left ; C =Carpus ; Mc.-P. =Metacarpo-phalangeal ; F.-I.—First Interphalangeal ; T.-A. =Tibio-astragaloid ; Strep. =Streptococcus ; Staph. =Staphylococcus ; Diph. =Diphtheroid ; S.-r. =Sporing-rod ; O =Sterile culture ; X =Growth in controls.

TABLE No. 4.—OF THE STREPTOCOCCI.

Case No.	Specimen	Joint	Culture	Hæmolysis	Bile Solubility	Lactose	Mannite	Salicin
3	S. Fluid	R. Carpus	Ærobe	O	O	A	A	A
3	S. Fluid	R. Carpus	Anærobe	O	O	A	A	A
3	S. Lining	R. Carpus	Ærobe	O	O	A	A	A
3	S. Lining	R. Carpus	Anærobe	O	O	A	A	A
3	S. Lining	R. M.-C. P.	Ærobe	O	O	A	A	A
4	S. Fluid	L. M.-C. P.	Ærobe	O	O	O	O	A
4	S. Fluid	L. M.-C. P.	Anærobe	O	O	O	O	A
4	S. Lining	L. M.-C. P.	Ærobe	O	O	O	O	A
4	S. Lining	L. M.-C. P.	Anærobe	O	O	O	O	A
4	S. Lining	L. M.-T. P.	Ærobe	O	O	O	O	A
4	S. Lining	L. M.-T. P.	Anærobe	O	O	O	O	A

N.B. S =Synovial ; R. M.-C. P. =Right metacarpo-phalangeal ; L. M.-T. P. =Left metatarso-phalangeal ; A =Acid ; O =No reaction.

observed throughout. Gelatin cultures were not made. All types produced a general turbidity when grown in broth, and the medium gave the indole reaction in all cases.

Upon the reactions in the "sugars" it was possible to differentiate the types, which approximated to the *B. neopolitanus*, *B. entericus*, and *B. acidi lactici*, as given in Hewlett (p. 450).

(*e*) *Other Organisms Isolated.* (Table No. 3).

Gram positive rods with rounded and/or square ends, and bearing oval subterminal spores, were encountered in the primary cultures of four samples. No attempt was made to identify these organisms which have been referred to as "sporing-rods." *B. proteus* overwhelmed the primary cultures of the capsule from the R. first interphalangeal joint of Case No. 3.

(*f*) *Sections of the Capsule after Cultivation.*

As reported under Technique, the specimens of capsule and its synovial lining were fixed and sectioned after cultivation in serum broth. Sections of these specimens which had remained sterile showed no evidence either of organisms or the products of their growth. In sections of the specimens producing organisms the bacteria were found clustered about the edges of the tissue, but it was evident that they had not originated in the tissue as no foci of organisms or of the secondary cell reaction to their presence were found.

(*g*). *Summary and Interpretation of the Bacteriological Examination.*

Table No. 7 gives a summary of the results obtained, and shows that 41 per cent. of the total number of primary cultures produced organisms. Of these, the organisms appeared pure in the proportion to mixed as 2 : 1.

The bacteria isolated show no constancy; for instance, the individual organisms in any one given mixed culture appeared pure in other cases. In each of the Cases Nos. 7, 29 and 34 the same sample produced an organism under anærobic conditions which was absent in the ærobic tube, and *vice-versa*, and yet these were organisms which in other cases were found to possess facultative anærobic properties.

The synovial fluid controls of seven specimens, and of one control case (C), in which both ærobic and anærobic primary cultures produced organisms, revealed the presence of organisms; whereas these controls remained sterile in the remaining cases in which the primary cultures proved sterile. Again, from two of the control cases (A and C) mixed as well as pure cultures resulted, involving organisms identical with those isolated from pathological specimens. In no instance was it found possible to attribute the source of contamination to the serum broth used, as none of the broth controls proved faulty.

These results may be expressed in another way, *viz.*—of the pathological cases 59 per cent., and of control cases 55 per cent. remained sterile.

When to these considerations is added the results of examining the sections of cultured capsules, the conclusion is reached that *the organisms grown represent contamination and are in no way associated with the lesions studied.*

The occurrence of organisms in the one tube of Cases Nos. 7 and 29 and their absence both in the second and the synovial control tube is difficult to explain otherwise than upon the hypothesis of contamination at the time of making the culture. On the other hand, the difficulties of preserving complete asepsis in a slaughterhouse are considerable, but, as is evident in the results, are not mountable. The best results were obtained with specimens of the synovial fluid and the bone, in which 69 per cent. and 73 per cent. of the cultures remained sterile. The removal of these samples is of brief duration, requires but one instrument, and follows directly upon the application of spirit flame to the site of operation. Whereas, on the contrary, 69 per cent. of the cultures of the capsule were contaminated, which is attributed to the exposure to the atmosphere of the joint structures, the removal of two separate samples in each case, the use of several instruments and the longer time required in the operation.

Finally, Table No. 3 also reveals that as the technique became more familiar contamination tended to become less frequent.

D. Of the Examination of the Morbid Anatomy.

For convenience of description the detailed pathological changes are considered under the headings of the structures affected.

1. *Lesions of the Bone and its Articular Cartilage.*

The initial abnormality consists of an hyperæmia of the bone which tends to remain circumscribed either immediately beneath or near to the articular lamella, though in several of the small bones of the tarsus the greater part of the cut surface has been found to be affected. This deep red coloration of the bone assumes a dark purple tint when viewed through the articular cartilage. Microscopically, the articular cartilage appears unaffected, whilst the marrow spaces of the underlying bone, though normal in contour, are crowded with dilated blood vessels.

At a later stage purple streaks or blotches are found beneath the articular lamella, and occasionally at the lateral aspects of the divided bone. Microscopically, the marrow cells in these areas have lost their vital staining properties, and the cancellous spaces now appear wider and more irregular, due to the disappearance of some of the trabeculæ. The remaining trabeculæ for the greater part have lost their healthy eosinophilic staining reaction and are revealed as pale violet structures which easily break or squash together in the process of cutting the section. Macroscopically, the affected region of the bone is rendered more porous and softer than normal.

Over these circumscribed congested areas in the bone the first structural alterations in the articular cartilage appear as the so-called "fibrillation," when having lost its smooth shining surface the cartilage assumes a dull opaque appearance, together with an uneven surface spongy to the touch. Microscopically, the external surface of the articular cartilage is ragged owing to the cleavage of the matrix into a mass of delicate filiform cylinders of cartilage, fragments of which are being cast off into the lumen of the joint (Fig. 1). These clefts pass inwards between vertically or obliquely distributed columns of matrix and cartilage cells penetrating in the more advanced specimens to the articular lamella itself (Fig. 2). In spite of this cleavage of the ground-substance, the cartilage cells themselves appear perfectly healthy; they preserve an alignment parallel with the clefts, while at the external extremity of many of these filiform cylinders the cells appear to have multiplied, forming oval shaped clusters each containing from 4-8 cells. At a more advanced stage of its dissolution, as shown in Fig. 3, the greater part of the original lighter staining portion of the matrix has disappeared, leaving an irregular whorled formation of the darker staining or more collaginous portion. Apparently healthy cartilage cells within a faint pink peripheral zone of matrix still remain dotted here and there as witnesses of their extreme tenacity.

The disappearance of the articular cartilage over the affected area continues until the underlying bone is exposed to the joint cavity—the stage of "erosion" (Fig. 4). The floor of the erosion is indented with pin-head craters containing red to purple-coloured soft tissue, and is also rendered more irregular by isolated shreds of adherent cartilage, or by little ridges varying in consistency from fibrous tissue to bone. The edges of the erosion, where the pathological insensibly merges into the normal, have a white, opaque and "gnawed-out" appearance. Some of the erosions examined appear from their shape and location to have been formed from the coalescence of two or three originally isolated foci. The porous condition of the affected area of cancellous bone is now well marked, especially in specimens which have been preserved in alcohol or else boiled. Microscopically, the floor of the erosion, which may contain nests of cartilage, largely consists of vascular granulation tissue. The articular lamella, according to the age of the lesion, may or may not remain intact. Beneath the articular lamella the marrow spaces are considerably enlarged through the disappearance

TABLE No. 5.—OF THE DIPHTHEROID ORGANISMS.

Case No.	Specimen	Joint	Culture	Hæmolysis	Bile Solubility	Motility	Lactose	Saccharose	Glucose	Mannite	Maltose	Salicin	Indole
4	S. Fluid	L. M.-C. P.	Ærobe	O	O	O	O	O	A	O	A	O	O
4	S. Fluid	L. M.-C. P.	Anærobe	O	O	O	O	O	A	O	A	O	O
4	S. Fluid	R. M.-C. P.	Ærobe	O	O	O	O	O	A	O	A	O	O
4	S. Fluid	R. M.-C. P.	Anærobe	O	O	O	O	O	A	O	A	O	O
11	S. Lining	L. M.-C. P.	Ærobe	O	O	O	O	O	O	O	O	O	O
11	S. Lining	L. M.-C. P.	Anærobe	O	O	O	O	O	O	O	O	O	O
17	Marrow and Bone	L. Carpus	Ærobe	O	O	O	O	A	A	O	A	O	O
17	Marrow and Bone	L. Carpux	Anærobe	O	O	O	O	A	A	O	A	O	O
29	Marrow and Bone	L. Tibio Astragaloid	Ærobe	O	O	O	O	O	O	O	O	O	O
29	Marrow and Bone	L. Tibio Astragaloid	Anærobe	O	O	O	O	O	O	O	O	O	O

N.B. S =Synovial; L. M.-C. P. =Left metacarpo phalangeal; R. M.-C. P. =Right metacarpo phalangeal; A =Acid; O =No reaction.

TABLE No. 6.—OF THE COLIFORM ORGANISMS.

Case No.	Specimen	Joint	Culture	Motility	Lactose	Saccharose	Glucose	Mannite	Maltose	Litmus Milk	Indole
3	S. Fluid	R. Carpus	Ærobe	O	AG	AG	AG	AG	AG	CA	X
3	S. Fluid	R. Carpus	Anærobe	O	AG	AG	AG	AG	AG	CA	X
3	S. Lining	R. M.-C. P.	Anærobe	X/O	AG	O	AG	AG	AG	CA	X
3	Marrow and Bone	R. 1st : I.-P.	Ærobe	O	AG	AG	AG	AG	AG	CA	X
3	Marrow and Bone	R. 1st : I.-P.	Anærobe	O	AG	AG	AG	AG	AG	CA	X
14	S. Lining	R. M.-C. P.	Ærobe	O	AG	O	AG	AG	AG	O	X
14	S. Lining	R. M.-C. P.	Anærobe	O	AG	O	AG	AG	AG	O	X
18	S. Lining	R. M.-T. P.	Ærobe	O	AG	O	AG	AG	AG	O	X
18	S. Lining	R. M.-T. P.	Anærobe	O	AG	O	AG	AG	AG	O	X
19	S. Lining	R. T.-A.	Ærobe	X/O	AG	O	AG	AG	AG	O	X
19	S. Lining	R. T.-A.	Anærobe	X/O	AG	O	AG	AG	AG	O	X
29	S. Lining	R. T.-A.	Anærobe								
32	S. Fluid	R. T.-A.	Ærobe	Not tested							
32 Control.	S. Fluid	R. T.-A.	Anærobe								
A	S. Lining	L. T.-A.	Ærobe	O	AG	AG	AG	AG	AG	CA	X
A	S. Lining	L. T.-A.	Anærobe	O	AG	AG	AG	AG	AG	CA	X

N.B. S =Synovial; R. M.-C. P. =Right Metacarpo phalangeal; R. 1st: I.-P. =Right 1st: interphalangeal; R. M.-T. P. =Right metatarso-phalangeal; R. T.-A. =Right Tibio-astragaloid; L. T.-A. =Left ditto; A =Acid; G =Gas; C =Clot.

TABLE No. 7.—OF THE INCIDENCE OF STERILITY AND GROWTH IN THE PRIMARY CULTURES OF ARTHRITIS AND NORMAL HORSES.

(*Summary of results shown in Table No.* 1.)

			Synovial Fluid.				Capsule and Synovial Lining.				Cancellous Bone.				Total All Samples	% All Samples
			Ærobic	Anærobic	Total	%	Ærobic	Anærobic	Total	%	Ærobic	Anærobic	Total	%		
Total No. of Samples			26	26	52	100	16	16	32	100	11	11	22	100	106	100
Arthritis Cases	Primary Cultures	Sterile	18	18	36	69	6	4	10	31	8	8	16	73	62	59
		Pure Growth	5	5	10	19	7	8	15	47	2	2	4	18	29	27
		Mixed	3	3	6	12	3	4	7	22	1	1	2	9	15	14
Total No. of Samples			3	3	6	—	3	3	6	—	3	3	6	—	18	100
Controls	Primary Cultures	Sterile	2	2	4	—	1	1	2	—	2	2	4	—	10	55
		Growth	1	1	2	—	2	2	4	—	1	1	2	—	8	45

of some of the bony trabeculæ, the remains of which are seen here and there as minute spicules of dead bone.

A striking feature of the vast majority of these lesions of the articular cartilage and bone so far described, is their duplication upon opposing articular surfaces.

The sites elected by the lesions of the articular cartilage vary. While the majority of lesions on opposing surfaces of the small bones of the carpus and tarsus appear adjacent to the marginal zone (Fig. 5), and those of the long bones appear more centrally, there is a minority of examples in which this distribution is reversed.

In Cases Nos. 1, 4, 5 and 11 another interesting lesion of the bone and its articular cartilage has been observed, and has been designated by the name of "furrowing." Macroscopically, the articular cartilages reveal one or more furrows and ridges, on the average about 1·0 m.m. wide, running parallel to one another in the line of movement of the joint, the ridge upon one surface fitting exactly into the furrow of the opposing surface like "tongue and groove" boarding (Fig. 6). In the left elbow joint of Case No. 1, the "furrowing" only affected the superficial portion of the opposing articular cartilages of the humerus and radius, while in the other three cases the furrows penetrated to the underlying bone. In the left tibio-astragaloid joint of Case No. 5, the furrows and ridges were formed of eburnated bone. In Cases Nos. 1, 4 and 11 the microscopic changes of the bone and cartilage corresponded to those described under "fibrillation"

There were other lesions found which demonstrated the subsequent changes upon the eroded areas already described. One of these is ankylosis, which occurred regularly in the affected hocks examined. In the majority of cases the opposing eroded surfaces were found adherent to each other through the medium of vascular fibrous tissue, whilst in three cases the ankylosis was of a bony nature. Even in these latter cases, which occurred between the small bones of the tarsus in two, and the carpus in one case, a fairly large proportion of the original articular cartilage persisted. The other change in the eroded surfaces is "eburnation" of the exposed bone. In these cases the exposed bone, instead of possessing a connective tissue covering, is thickened and polished. On section, the sclerosed bone is extremely dense with obliteration of the marrow spaces adjacent to the surface, the deeper spaces being filled with fat. There is no regeneration of the articular cartilage which at the now even edges of the lesion is as thin as parchment.

2. *Lesions of the Non-Articular Surfaces of the Bone.*

Eight specimens illustrating a series of pathological changes in the non-articular surfaces both of the intra and extra-capsular portions of the long bones were found in four cases (Nos. 1, 3, 11 and 34). With the exception of the isolated exostosis of Case No. 1, the specimens consisted of new formations upon the surfaces of either the os suffraginis or os coronæ, and were associated with some lesion of the adjacent articulation. They are examples of the so-called "articular ringbone." The earliest phase of their development was observed in Case No. 3, as a whorl of fibrous tissue bundles surrounding a central vascular core which, on dissection, was seen to emerge as a blood vessel through a foramen in the bone. Formations of a similar structre lay adjacent to one another. Each fibrous whorl was clothed by and had become interlaced with, the periosteum, which over the remainder of the bone was reddened and somewhat thicker than normal. Microscopically, the vascular core consists of dilated blood vessels surrounded by a very loose reticular connective tissue which in turn passes into the very tough and closely packed layers of fibrous tissue.

At a later stage bone is laid down around the vascular core, so that the outgrowth consists mainly of a soft osteoid tissue. In saw-sections of still larger exostoses the central bony mass is seen to be a direct extension or outgrowth of the pre-existing bone. The greater mass of the exostosis consists of layers of fibrocartilage and fibrous tissue filling in the indentations upon the external aspects of the central bony core, and presenting a smooth surface to the tendons and other more superficial structures.

In four of the specimens the exostoses merge into, and structurally are indistinguishable from, the osteophytes lining the articular margins.

These exostoses grow in the line of least resistance into the loose fascia of the limb. They become deflected in their course or flattened in shape by tendons and ligaments, grooved and indented by arteries, while the overlying skin becomes in the more advanced cases an added factor in the directing of their line and form of growth.

Of a similar nature are the two specimens of chronic arthritis of the vertebral column (Nos. 22 and 23). Space will not permit of description of this arthritic manifestation in the vertebral column, and it has been decided to include this in a series of cases which will be published shortly under the heading of "*Spondylitis Deformans.*"

3. *Lesions of the Joint Capsule.*

In the course of his studies upon the morphology and physiology of the joint structures, the author has encountered so many objections to the consideration of the capsule lining as a separate structure that it has been decided to discard the term "synovial membrane" in favour of "synovial lining." Briefly, the capsule may be deemed to consist of tough layers of white fibrous and yellow elastic tissue containing blood vessels, nerves and collections of fat. The relative proportions of these fibrous layers and reticular tissue vary in the different aspects of any one joint. Generally speaking, the inner surface of the parts of the capsule not exposed to constant friction and pressure consists of a proportionately large amount of reticular tissue, and it is in these positions that the villous processes of the capsule are found. Finally, the shining luminal surface of the capsule is lined by mesoblastic cells, the so-called "synovial cells." Thus the term "synovial lining" merely indicates reticular tissue upon the luminal surface of the capsule.

Macro- and microscopically the initial changes observed in the capsule are those of a simple hyperæmia. The reticular tissue of the capsule becomes swollen and infiltrated with a yellowish-brown serous effusion, which oozes from the cut surface in the freshly-killed animal. On cooling, this effusion in the tissues assumes the consistancy of jelly. Microscopically, the tissues appear healthy, though their spaces are filled with a homogeneous pale-violet-staining material. However, within the section there appear small irregularly-shaped areas in which the cells have broken down, leaving a structureless mass of tissue and the ghostly remains of a former connective tissue meshwork (Fig. 7). These areas of necrosis, which are surrounded at a later stage by a peripheral zone of young granulation tissue (Fig. 8), contain no evidence of bacteria or of the products of their activity.

Proliferation of the softer structures of the capsule now ensues. The villi become individually enlarged and branched and collectively increased in number, so that, dropping such a piece of synovial lining into fixative, its villi wave about in the solution like the tentacles of a sea-anemone. Microscopically, the blood vessels are not, as previously, distended with blood, but there is a considerable increase in their number to account for the macroscopic hyperæmia of the synovial lining. The endothelium of these vessels is normal (Fig. 9). Young granulation tissue in the form of fibroblasts, of recently formed short fibres, and of large oval vacuolated epitheloid cells containing faintly-staining oval or kidney-shaped nuclei is found, not only replacing the foci of necrosis but also spreading diffusely throughout the tissues. In some sections certain of these latter cells are seen to be considerably swollen with globules of a brownish-yellow material, others with pigment granules, suggesting their function as that of wandering phagocytic cells (Fig. 8). Occasionally, a few scattered cells, each resembling a giant cell, with 4 to 6 central nuclei, are found among the young connective tissue. The synovial cells are increased in number, especially at the bulbous extremities of the villi where they are frequently found two or three

layers thick. Sometimes where the villi have been cut obliquely, small clumps of these synovial cells have been found lying adjacent to, or even detached from, the villi (Fig. 10). Also, actually within the structure of the innermost layer of the capsule there are found straggling collections of plasma-like cells which bear an accurate resemblance to the free synovial cells described under Cytology. After making careful measurements in the variously-stained sections it was found that the synovial cells vary slightly in size and shape with their location; for instance, those actually forming the single-cell lining of a villus have an oval or a somewhat flattened, endothelial-cell-like shape, whereas the outermost cells of a lining three layers thick are ovoid, and resemble the free cell in the centrifuged deposits of the synovial fluid.

With the development of the proliferative process, the capsule and synovial villi, which take on a russet hue, lose their swollen and œdematous appearance. Adult fibrous tissue is now being laid down in increasing amount, and, as in the former stage, shows a characteristic relationship to the blood vessels. Around each centrally-placed blood vessel this fibrous proliferation is arranged in whorls, so that on transverse section a villus appears as a collection of blood vessels, each of which is encircled by layers of fibrous tissue, a feature described by Timbrell Fisher[24] (1923) as "peri-capillaritis diffusa" (Fig. 11).

In the subsequent stages the synovial lining assumes a smooth, shining, greyish or porcelain-white surface, which is irregularly corrugated by the more deeply situated bands of fibrous tissue. The villi are now reduced or entirely absent. Fibrocartilage and bone formation is found within the capsule. Microscopically, the fibrous tissue is extremely dense, showing but few nuclei; the blood vessels are surrounded by thick layers of fibrous tissue, and many of the smaller vessels are completely occluded (Fig. 12).

Four cases (Nos. 3, 5, 11 and 34) produced examples of what are described as "herniæ of the synovial lining" in spite of Ely's statement[29] (1923) that "there is, of course, no such thing as a hernia of a joint." In their earlier stages these formations can be seen as localised pouches increasing the capacity of the joint cavity already distended with excess of synovial fluid. On dissection it is found that the synovial lining has either bulged into the utmost limits of the loose spaces on the periphery of the luminal aspect of the capsule, or passed *via* the vascular pathways through the entire thickness of the capsule to the exterior. In these earlier stages the walls of the herniæ are soft and compressible and reveal microscopically a structure identical with that of the synovial lining in the stage of hyperplasia. From dissection it is obvious that these two varieties of protrusion of the synovial lining have in their expansion followed the line of least resistance, and owe their conformation to the disposal and functions of the adjacent denser tissues, *e.g.*, ligaments and tendons (Fig. 13). In the advanced stage of development (*e.g.*, Case No. 3), metaplasia within the walls of the intra-capsular protrusions leads to contraction of their lumena, while the extra-capsular or true herniæ become fibro-cartilaginous or bony cysts lying between or over the tendons.

The connection between the lumena of the joint cavity and the hernia becomes constricted by the contraction of the capsule, resulting, as in Case No. 3, in its limitation to a narrow pedicle.

Case No. 34 provided the only example of cartilaginous metaplasia within a villus, *i.e.*, a pea-sized chondroma within the left tibio-astragaloid joint.

4. *Lesions of the Marginal Zone.*

The articular cartilage, periosteum and synovial lining of the capsule become inseparably interwoven at "that margin of articular cartilage which is exempt from the influence of external forces" (Toynbee[61] 1841). This in the words of Hunter[54] (1747) "might be called the *Circulus Articuli Vasculosus*, the vascular border of the joint." It is found preferable by utilising the term "marginal zone" to retain the original concept of its specific properties rather than to associate the region with the articular cartilage, of which Fisher[23] deems it to be the "lateral area."

The marginal zone has proved to be the most frequently affected region in all of the joints examined. In the initial stages the blood vessels of the zone are rendered unduly prominent, together with localised reddening of the spongy bone immediately below. There follows the macroscopic swelling and the microscopic focal necrosis as described in the capsule. From the periphery of this swollen and congested marginal zone minute vascular twigs are seen with the naked eye, jutting outwards. This young vascular connective tissue is seen to advance as a pink fleshy layer in one or all of three directions, *viz.*, on to (1) the intact and apparently healthy articular cartilage, constituting the so-called "pannus," (2) the synovial lining of the capsule described, and (3) the non-articular surface of the bone.

Metaplasia of the proliferated marginal zone ensues, when on section it is seen that osteoid tissue has become incorporated in and has extended the underlying cancellous bone into a lip covered with fibrocartilage. This formation, the so-called "lipping," may involve a portion or the whole of an articular margin of any one bone. Subsequently, spongy bone, the serrated external surface of which is rendered smooth by a layer of fibro-cartilage, constitutes the new formation. This appears to be the stage to which the name "osteophyte" formation applies.

In their final stage of development the osteophytes assume varying conformations. For example, the proliferated marginal zone becomes recurved towards the opposing articular margin, and frequently possesses an edge as sharp as an ivory paper-knife. Such recurved bony ridges on opposing margins grow until they become interlocked by their respective serrated edges, eventually ankylosing and constituting the so-called "spurious or pseudo-ankylosis." On the other hand, osteophytes have been seen advancing on to the non-articular surface of the bone to become intimately incorporated with exostoses. Or they may project outwards from the articular margin between and alongside the fibres of the interarticular ligaments. A growth of this latter variety, in which a localised cluster of osteophytes has projected outwards as a consolidated mass on the antero-internal aspect of the scaphoid and os magnum, is seen in Case No. 26. Less commonly, as seen in Cases Nos. 3 and 33, fringes or even comparatively thick wedges of the synovial lining overlie and even become adherent to the osteophytes.

In Cases Nos. 3 and 5, osteophytes which at first sight appeared to be villous chondromata were found suspended within the joint cavity by delicate fibrous pedicles. From their structure and situation it was concluded that they represented osteophytes which had been fractured at their junction with the bone, but their fibrous cap and vascular supply had remained intact, and consequently growth had not been arrested (Fig. 14). In other joints examined, occasional delicate osteophytes were found with but slender bony attachments which only required a very slight knock to effect their fracture. No actual "loose bodies" were found free within the joint cavity.

5. *Lesions of the Interosseous Ligaments.*

As a general rule, no abnormalities were found in the interosseous ligaments; in occasional joints they showed an increased vascularity. Whenever movement was present in a joint even with advanced changes both in its bones and capsule, no morbid change in the ligaments other than increased vascularity has been observed. However, in two hocks showing bony ankylosis between the small bones the associated interosseous ligaments contained bony spicules penetrating from their sites of insertion.

The previously-described growth of osteophytes in the direction of, and in intimate association with, the fibres of the interosseous ligaments, especially of the small bones of the carpus and tarsus, has been mistaken by various authors including Roloff[51] (1866), Smith[56] (1893), Kruger[43] (1906) for ossification of the ligaments themselves. As early as 1869, Schutz[55*], stated that the hyperostoses

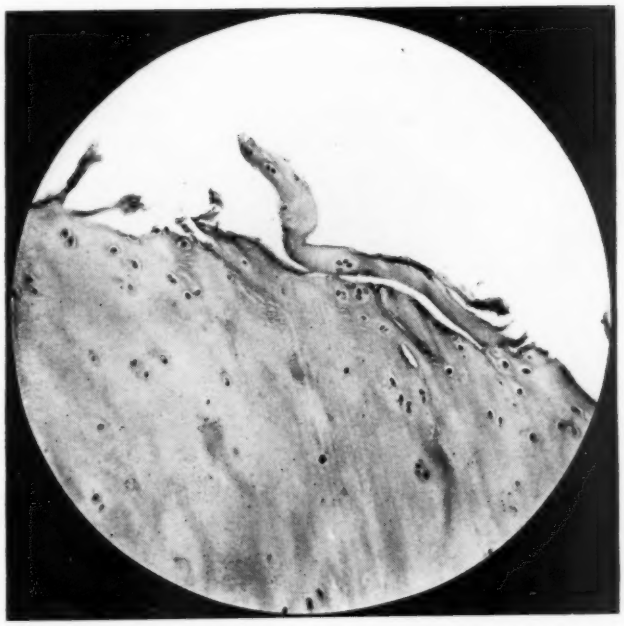

FIG. 1. Early stage of fibrillation of the articular cartilage, showing cleavage of the superficial layers. x. 150.

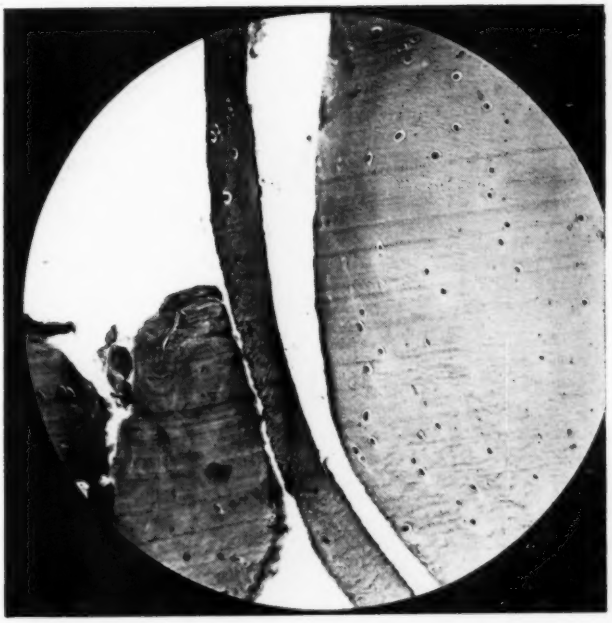

FIG. 2. Fibrillation of the articular cartilage, showing oblique cleavage of the matrix to a greater depth than in Fig. 1. x. 150.

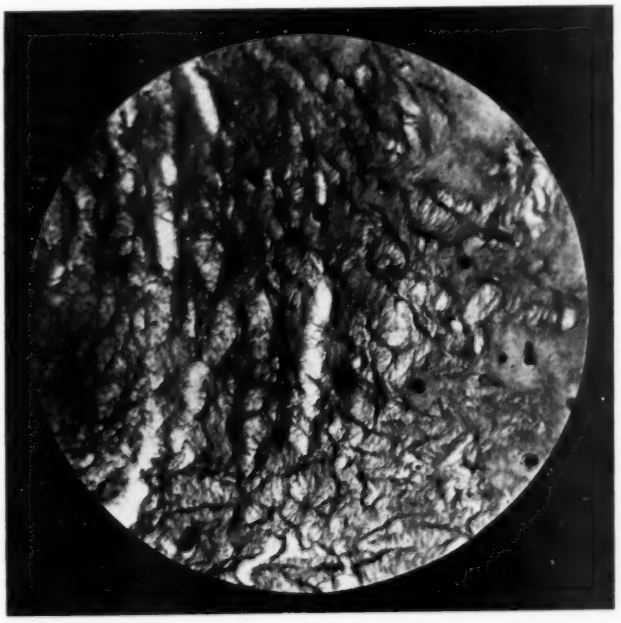

FIG. 3. Advanced stage of fibrillation of the articular cartilage, showing dissolution of the matrix, which still contains a few isolated and apparently healthy cartilage cells. x. 250.

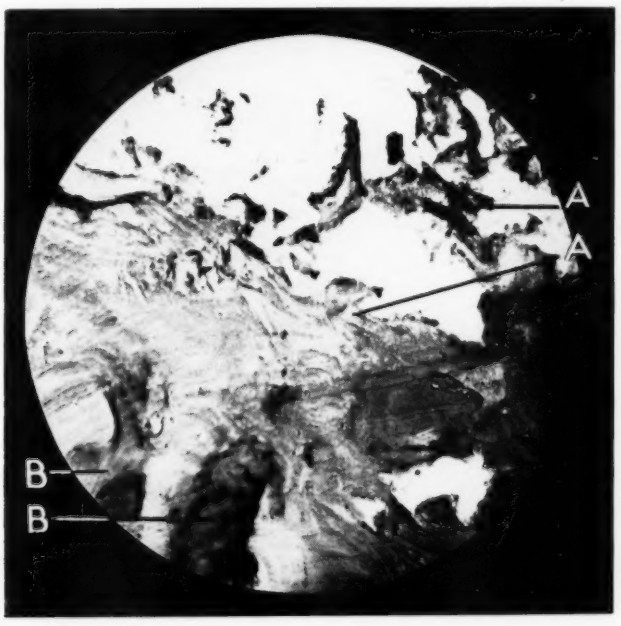

FIG. 4. Section through the articular lamella, the external surface of which contains the last remaining shreds of the cartilage matrix (A); the cancellous spaces (B) contain vascular granulation tissue. x. 250.

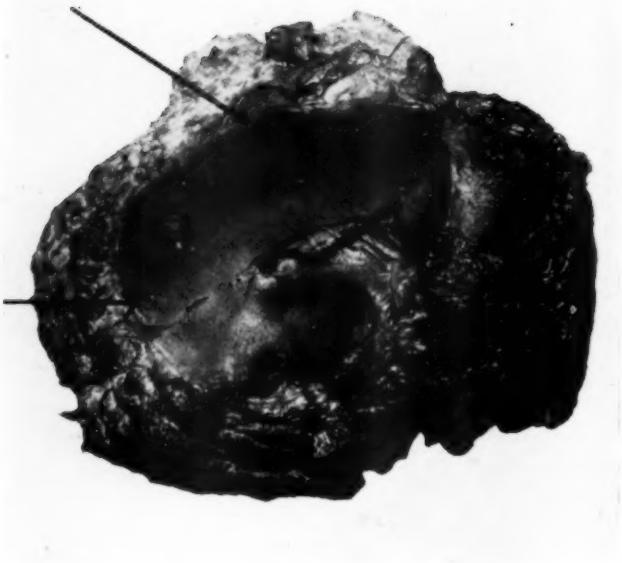

FIG. 5. Upper surface of the right superior intertarsal articulation, showing a semilunar erosion of the cartilage adjacent to the marginal zone of the scaphoid.

FIG. 6. Left tibio-astragaloid joint from above and flexed to show " furrowing " of the cartilage on the trochlear of the astragalus.

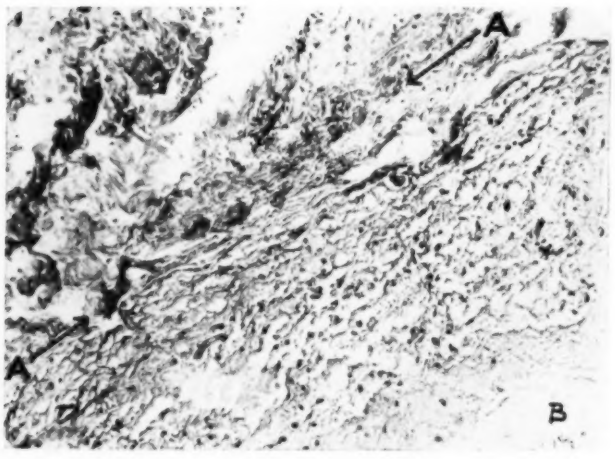

FIG. 7. Focal necrosis in the capsule. Above the line (AA) the tissue is normal, below it is loosing its vital characteristics, both cells and reticulum breaking down into a structureless material (B). x. 250.

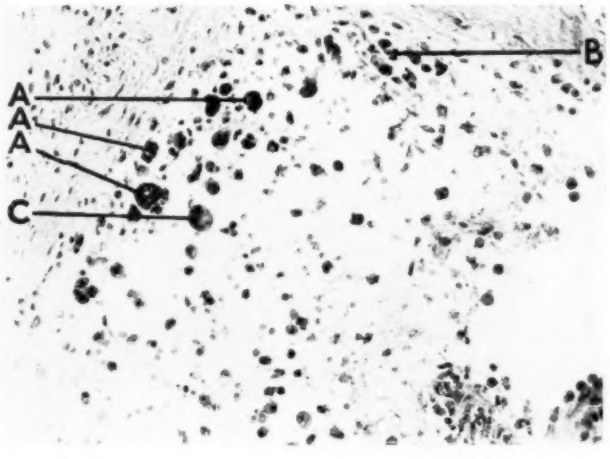

FIG. 8. Young granulation tissue replacing a focus of necrosis in the capsule ; A—phagocytic endothelial cells containing pigment ; B—granules of pigment ; C—multinucleated cell. x. 250.

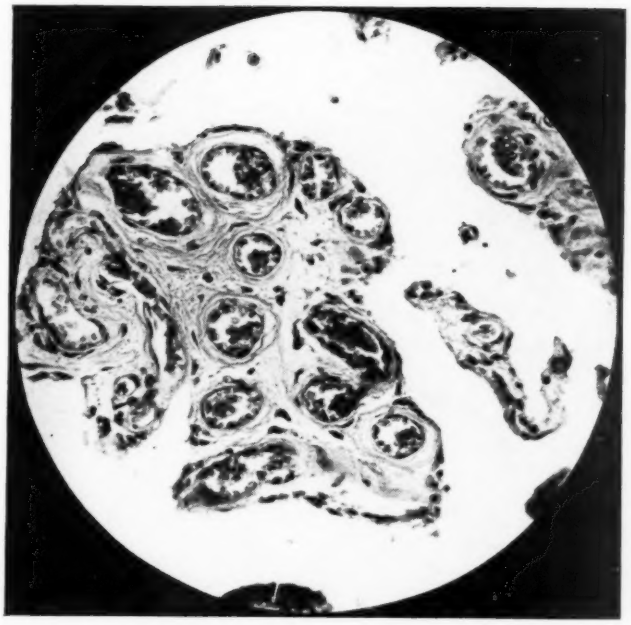

FIG. 9. Hyperplasia of a villus (T.S.) showing increase in the number of capillaries which are lined by normal endothelium. x. 250.

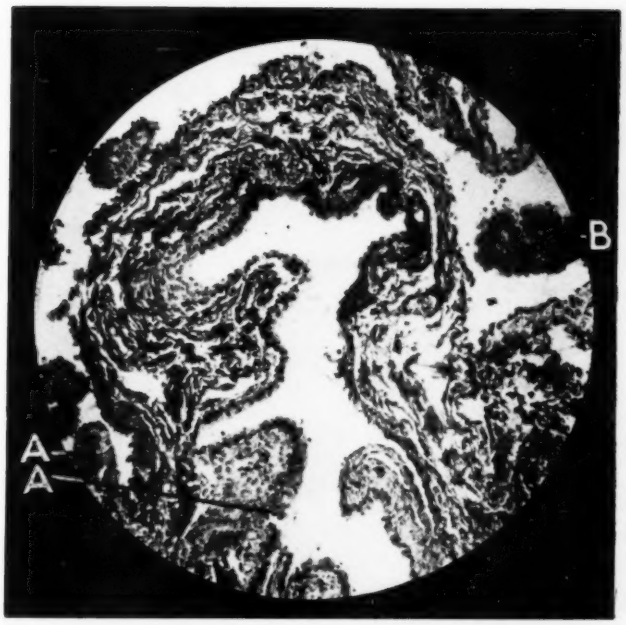

FIG. 10. Hyperplasia of a villus (L.S.) showing proliferation of the lining synovial cells (especially at A) clumps of which are lying free (B). x. 150.

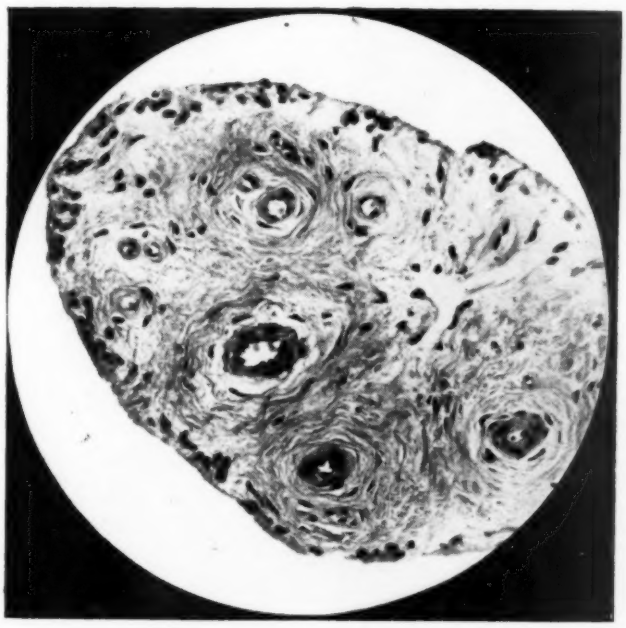

FIG. 11. Later stage of hyperplasia of a villus (T.S.) showing Timbrell Fisher's "peri-capillaritis diffusa." x. 250.

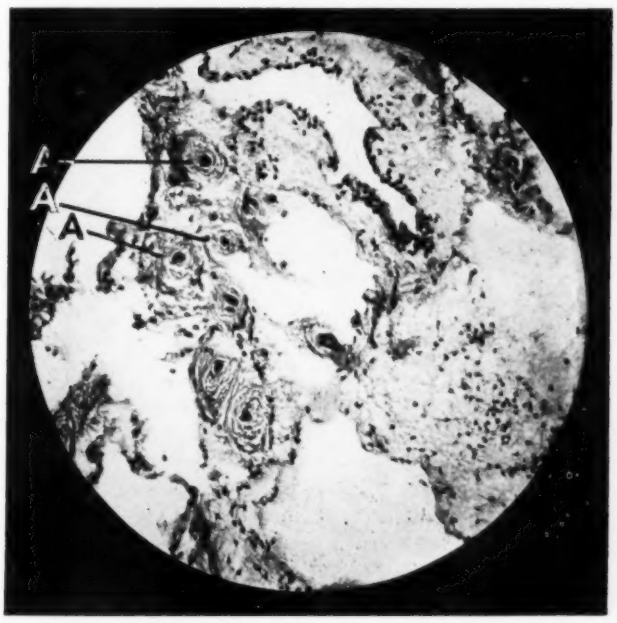

FIG. 12. Villus undergoing atrophy showing the remains of occluded blood vessels (A). x. 250.

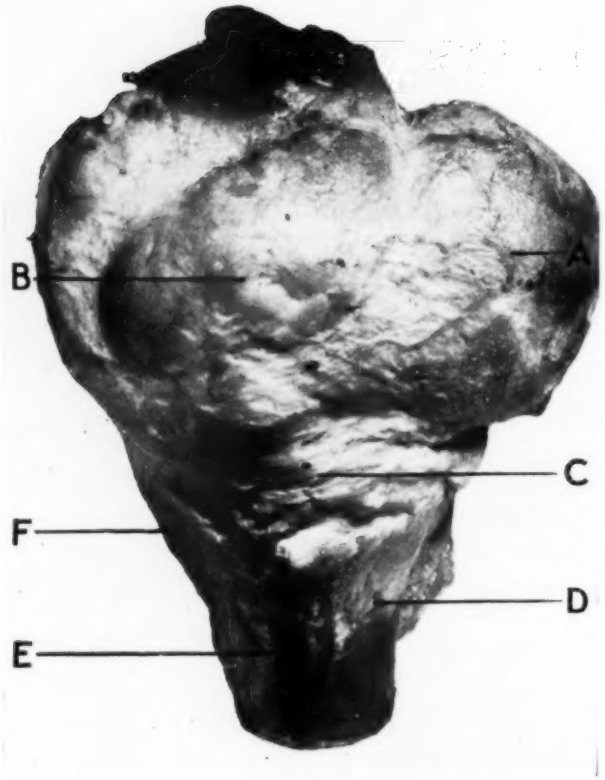

FIG. 13. Anterior aspect of right carpus (Case No. 3) on removal of skin and fascia, showing herniation of the synovial lining through the capsule. A—inner boss, and B—outer boss, each consisting of two distinct herniæ united by metaplasia within their walls; C—pouch of extensor pedis sheath; D—insertion of extensor metacarpi magnus; E—extensor pedis; F—extensor suffraginis.

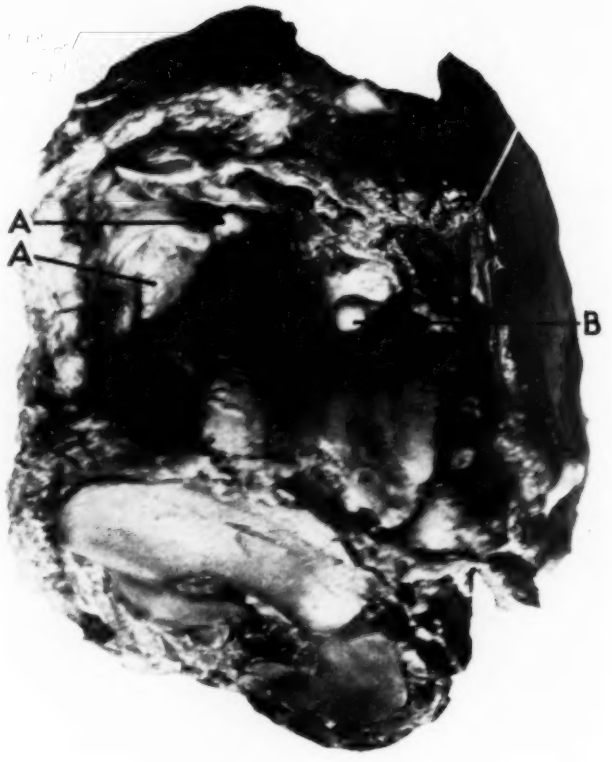

FIG. 14. Left tibio-astragaloid joint from above and below, showing osteophyte formation (A) on the anterior articular margin of the tibia, with a pea-like osteophyte (B) suspended by a fibrous pedicle.

FIG. 15. Piece of flexor perforans tendon (Case No. 16) showing tangled appearance of the fasciculi in its inner half. The hyperplastic sheath has been reflected.

in spavin arose from the junction of the synovial lining and periosteum, never from the insertions of the interosseous ligaments; an observation which in 1897 was confirmed by Eberlein[19].

6. *Changes in the Tendons and their Synovial Sheaths.*

In the tendon synovial sheaths of nine of the twenty-one cases studied (*i.e*, 43 per cent.), varying degrees of changes occurred analogous to those already detailed in the joint capsule. Both the parietal and reflected layers of the synovial lining showed an intial hyperæmia followed by swelling due to a serous infiltration of their loose reticular tissue. At a later stage vascular adhesions between the synovial surfaces have been seen (Case No. 11). In the tendons beneath the reflected synovial lining identical changes are found. The reticular tissue between the bundles becomes infiltrated, the tendon itself becomes soft and slightly swollen and, as illustrated in Fig. 16, in an extreme degree of softening the individual macroscopically-healthy fasciculi may be, as it were, teased out into a tangled-string-like appearance. Similar changes in the perforans tendon over the seat of navicular disease have been described by Smith[56] (1893). Macro- and microscopically the subsequent changes of hyperplasia with villous proliferation in the synovial sheath and thickening in the tendon, followed by metaplasia, have been observed, resulting in the formation of bands and whorls of fibrous tissue, nodules of fibro-cartilage, or even cylinders of bone within the tendon itself. These proliferative changes have been observed to spread from the sheaths not only on to the capsule of the adjacent joint but up and down the tendon into the fascia of the limb, and to such structures as the lateral cartilages of the os pedis.

Summary of the Morbid Changes.

Pathological changes have been found firstly, in any one structural unit of the joint, *viz.*, the bone and its articular cartilage, the non-articular bone, the capsule and its synovial lining, the marginal zone, or of the tendons with their synovial sheaths; and secondly, in any combination of these individual units of the joint and tendon sheaths. An analysis of the twenty-one cases shows that the incidence of pathological change in the three principal structures reads as follows:—bone and its articular cartilage, 40 specimens; marginal zone, 47; capsule, with its synovial lining, 37; and it also shows that any one of these three structures may be affected independently of the other two.

Again, it has been found that while in any one structural unit of the joint the lesions are of a similar stage of development, this constancy is not necessarily present throughout the lesions of any combination of these units in the same joint. For instance, the lesions of the synovial lining may show an early stage of development when the bone and its articular cartilage manifest advanced changes.

Finally, there is no constancy in the stage of pathological change between one joint and another in the same patient.

Thus, in the series of patients it has been possible from the various presentations of morbid changes to reconstruct a chain of development of the lesions of chronic arthritis. In all the structures affected the *initial* morbid change is an hyperæmia, which is followed by the effusion of an acellular fluid into the tissue spaces. The first evidence of damage to these tissues is manifested as a type of *focal necrosis*. These foci contain no bacteria or the products of their activity. The serous effusion has not been identified in the bone, but corresponding to the focal necrosis in the soft tissues there is the focal absorption of the cancellous bone. Subsequently the soft tissues react to the injurious factor by an *hyperplasia* of their constituent elements; *it is a generalised increase of the elements, not just a replacement fibrosis corresponding to the focal necrosis.* This connective tissue increase is intimately related to the blood vessels, around which a perivascular fibrosis takes place. (The changes in the non-articular areas of the bone follow a similar course.) The absorption of cancellous bone may be followed by focal fibrillation and erosion of the overlying articular cartilage.

Here is it pertinent to emphasise that the regions of the osseous skeletal system containing these lesions are those bones or portions of bones constructed of cancellous bone, and supplied by numerous blood vessels passing in from the periosteum.

Hyperplasia in the soft structures and the non-articular bone is followed by *metaplasia*, resulting in the formation of fibrocartilaginous or bony nodules within the capsule or tendon sheaths, chondromata in the synovial lining, osteophytes upon the marginal zone, and exostoses upon the non-articular surfaces of the bone. Throughout these proliferative phases the fibrous tissue has thickened and contracted, resulting in (a) altered alignment of the joint surfaces when the contracting forces have been uneven, or (b) the gripping of opposing surfaces as in a vice when those forces have been balanced. Also similar changes in the tendons or in their sheaths by the unbalanced contraction upon the joint assist the alteration in alignment of the articular surfaces.

The nutrient vessels to the part are constricted by the increasing forces of contraction and metaplasia and the consequent *atrophic* changes are especially felt in the synovial linings of the joint and tendon sheaths.

Reconstruction also takes place in the "articular" bone, but *never* in the articular cartilage. During the disappearance of the articular cartilage the deposition of new bone in the underlying cancellous tissue commences. The two final results of this loss of the articular cartilage are of a different degree. Firstly, if the disappearance has been gradual, by the time the articular lamella is exposed, a layer of sclerosed bone has been formed to withstand the pressure of the similar lesion on the opposing articular surfaces. Then, with the retention of movement between the surfaces the exposed bone becomes polished, and at the same time goes on proliferating into a dense layer of ivory consistency (so-called "eburnation"). Secondly, if the bone has been exposed in a more rapid manner, *viz.*, by erosion, granulation tissue advances from the marrow spaces on to the affected area. If movement in the joint ceases from other causes, the opposing areas of granulation tissue become interlocked, metaplasia supervenes, resulting in fibrous, or later, bony ankylosis. If, on the other hand, movement between the opposing surfaces continues, the granulation tissue eventually becomes converted into calcified areas (the "lime points" of Eberlein[19]) and subsequently absorbed, with the end result that the bone has by then found a sufficiently sclerosed layer to withstand the stresses of muscle and body weight.

These various forms of structural change will now be examined in greater detail from another aspect; namely, their relationship to one another and to the findings recorded under their several headings, in the hope of identifying the pathogeny of chronic arthritis.

(*To be continued*).

Army Veterinary Service.

London Gazette—War Office—Regular Army Reserve of Officers.

April 26th.—Capt. W. E. Phipps, late R.A.V.C. (Mila.), to be Capt. (April 12), with seny., Dec. 11, 1922.

Territorial Army.

Maj. W. H. Anderson resigns his commn. and is granted the rank of Capt. (April 27).

CLINICAL AND CASE REPORTS.

Hemiplegia in a Clydesdale Gelding, with Partial Recovery.*

By R. E. DRENNAN, M.R.C.V.S., Aberdeen.

The subject of these notes is a bay Clydesdale gelding, about 9 years old, whose environment and feeding were governed by the usual laws of Hygiene and Dietetics. He was regularly worked and carefully driven on a farm on the outskirts of the city. On the morning of 19th October, 1926, the owner observed that the animal had great difficulty in moving forward in his stall when the morning feed was put in the manger, and on more careful examination it was found that he was sweating profusely on the right side of the body, and looking rather excited as if he had been scared by some object in his forestall. On attempting to back him out of the stall it was found that his legs refused to move.

Nothing unusual having been observed the previous evening, the owner was rather alarmed, and my advice was immediately sought.

On examination I found the animal in the state aforementioned; he was completely paralysed in the right foreleg, along the muscles of the right side of the body, and in the right hind leg. There was no indication of either dilatation or contraction of the pupils, but in certain positions of the head, when slightly exposed to the light, the retina of the left eye seemed to be congested, and the animal appeared very excited. There was no reflex response on the right side of the body, the whole of which, apart from the head and neck, appeared paralysed. A very guarded prognosis was given.

I decided to have him transferred to a loose box for convenience and comfort, and with the assistance of my friend Mr. Moir, we had him removed from the stable, with the greatest difficulty, to a box some fifty yards distant. When no assistance was given the animal could not move one pace, but by fixing a rope to the right fore pastern and another to the right hind pastern we were able to move the right legs forward with careful manipulation. The right foreleg, in particular, was very difficult to move. The process of removal to the loose box about fifty yards away occupied the best part of an hour, but we were quite satisfied with the fruits of our labour.

I explained to the owner the danger of him assuming the recumbent position, and advised slings. The owner did not seem very keen on this procedure, so we made the animal as comfortable as possible, administered a dose of physic, prescribed internal medication with potassium iodide, and advised massage of the affected limbs. On the following day the animal was in much the same state, except that the initial profuse perspiration had ceased, and the bowels were responding freely to the physic administered.

On the second day, however, he lay down in the box and was, as anticipated, unable to rise. The work entailed in raising him is perhaps better imagined than described, and I fully expected a fatal issue during the procedure, his pulse being weak and thready.

My fears, however, were not realised, and we eventually got him into slings, in which he stood for five weeks. I then considered light exercise would be beneficial, and commenced it. He had very little control over the affected legs during the first two weeks after his removal from slings, but by the end of the third week he was given light work in chains, which appeared to have a steadying effect on his equilibrium. As time went on he was able to work fairly well, but the weakness is still quite patient in the plough.

Pathogenesis. The trouble would appear due, either to an extensive lesion of the motor area of the left cerebral cortex, or to a small lesion of the internal capsule of the left cerebrum, where the motor fibres are concentrated, the lesion in all probability, from the sudden onset of symptoms, being due to rupture of a cortical blood vessel, with resultant clot, so that we have destruction of function of the motor area affected by the clot, with descending degeneration of the direct and crossed pyramidal tracts, emanating from that area. The first effects of the clot would be manifested by the stage of rigidity, evidenced by the difficulty in moving the affected limbs; this later would be followed by the stage of relaxation, when movement again becomes possible. It is, of course, well known that complete paraplegia is not so prone to persist in the lower animals as in the human subject, as is evidenced by Sherrington's classical experiment in the decerebrated dog, from which it was deduced that cells of the basal ganglia gradually took on the function of the cerebral motor cells. Further, the cells of each hemisphere are closely connected by the commissural fibres, so that the cells of the sound side take on the function of those destroyed in the other hemisphere. There are further commissural fibres connecting the crossed and direct pyramidal tracts in the cord, so that even complete degeneration of the left pyramidal tracts does not necessarily imply complete hemiplegia affecting the right side of the body. It would appear that the motor area for the face was not affected by the clot, as there is no evidence of interference with the facial muscles. Muscles used bilaterally usually escape interference by hemiplegia, due, it would appear, to the centres in each hemisphere controlling these muscles being closely connected, so that their function on destruction of one set of centres is regulated by the corresponding centres in the sound hemisphere. This explains the escape of the chest and abdominal muscles which, of course, act bilaterally.

Prognosis. Whether or not complete restoration of function will take place would appear to depend on two basal conditions: firstly, complete absorption of the clot, when complete restoration of function of the underlying area might be hoped for, and secondly, the corresponding centres of the opposite hemisphere through the commissural fibres completely taking on the function of the destroyed centres, or the corresponding sound tracts taking on the function through the commissural fibres of the cord.

Should neither of these events occur, it would appear that partial hemiplegia will persist indefinitely.

These conditions being problematical, the prognosis, of course, remains guarded.

* Case presented to the North of Scotland Division at Aberdeen on 26th March, 1927.

A Case of Œsophageal Fistula complicated with Traumatic Pleurisy, with no Pleuritic Symptoms.*

By R. E. Drennan, M.R.C.V.S., Aberdeen.

The subject of this abnormality was a six-year-old milch cow, in good condition, and a heavy milker.

My services were first required for the animal one evening in January, 1926, when I found her suffering from acute rumenal tympany, and exhibiting the classical symptoms of choking, with profuse salivation.

The history elicited was that the animal, on root diet during the winter of 1924-1925, had been subject to repeated attacks of choking, the first of which was very severe, while the succeeding attacks were apparently milder, passing off in a few hours without treatment. During the summer of 1925, while at grass, the animal did exceptionally well and showed no sign of abnormality whatsoever. In Autumn, on return to root rations in the house, the attacks of choking recurred as in the previous winter, on each occasion passing off spontaneously until the night in question, when I was called in to treat her on account of the severity of the attack accompanied by acute tympany of the rumen.

On examination, I found the animal very tympanitic, and exhibiting all the symptoms associated with œsophageal obstruction. The pulse was small and weak, in keeping with the tympany present. Passage of the probang was accomplished without difficulty, and the tympany immediately subsided. I gave the animal a drink of water, which she took quite readily and easily.

While the owner was furnishing me with the anamnesis in detail, the tympany reappeared. I again passed the probang, but on this occasion there seemed to be some obstruction about the lower third of the œsophagus in the region of its entrance to the thorax. By manipulating the probang backwards and forwards, with simultaneous rotation, the obstruction appeared to be overcome and the tympany again subsided. Its reappearance a third time with the same difficulty in passing the probang made the prognosis very unfavourable, and I submitted the owner a tentative diagnosis of either œsophageal diverticulum or tuberculous hyperplasia of the mediastinal lymph glands. The animal being in good condition, I advised slaughter, which was carried out forthwith, and autopsy revealed a large œsophageal diverticulum, not unlike the suburethral diverticulum of female bovines, but much larger, and with an extensive old-standing perforation of its fundus, the edges of which were quite necrotic. The pleural cavity, especially in the dorsal portion, was packed tightly with a mixture of hay, straw, and other foodstuffs, which from appearance had lodged there for a considerable period. There was a chronic fibroplastic pleurisy present on removal of the foreign food material.

The interesting feature of this case, to my mind, was not the œsophageal diverticulum, which was not difficult to diagnose from the detailed history coupled with passage of the probang, but the fact that, although absolutely no visible pleuritic symptoms were apparent during life, the pleura was the seat of a chronic traumatic pleurisy, the dorsal aspect of its cavity being literally packed with masticated food, which had apparently found its way there through the fundibular opening in the œsophageal diverticulum, and been resident there for a considerable period, although causing no apparent inconvenience to the animal.

* Case presented to the North of Scotland Division at Aberdeen on 26th March, 1927.

Miliary Tuberculosis of the Lungs in a Draught Horse.*

By R. E. Drennan, M.R.C.V.S., Aberdeen.

The subject of these notes was a seven-year-old Clydesdale, employed as a draught animal by a local coal company. There was in the Company's stable an extensive and protracted enzootic of equine influenza, spread over a period of several months, three or four animals being affected at one time. With the usual treatment of fresh air, thoracic counter-irritation, and trust in Providence, all recovered, with one exception—the animal referred to.

This animal, like the others, appeared to be sufficiently recovered, as evidenced by improved appetite, and fall in temperature and pulse, to be allowed slow walking exercise, but immediately on commencement of this his temperature rose again to 104° F. He was again completely rested and in three days' time his temperature and pulse were again more or less normal, and exercise was again prescribed. The temperature once more rose to 104° F., and he went completely off his food.

In the course of another week the temperature was again normal, although the pulse remained about 56, respiration slightly accelerated, and the appetite none too good. Pleurisy was suspected, although auscultation revealed no sign of it, and paracentesis thoracis was carried out—with negative results.

Counter-irritation in increasing degrees of severity was applied to the chest walls, starting with embrocation, followed by mustard, then by capsicum, and finally by hot fomentations and liquid cantharides blister, combined with intravenous medication with Diekerkoff's iodine solution, and half per cent. formalin solution, but the only effect was an ephemeral fall in temperature to around 102° F. The temperature henceforward continued to fluctuate from 100° F. to 103° F., pulse about 60, and the possibility of tuberculosis was considered.

Four drops of ophthalmic tuberculin were instilled into the right conjunctival sac, but with negative result, and it was considered that the fluctuating temperature and pulse might be due to toxin absorption during the initial attack of influenza.

Accordingly, a rest in the country was advised, but the temperature continued to fluctuate, although the appetite and pulse improved. Progress was maintained for a few weeks, but eventually the animal became less eager for food, and the fluctuation in temperature was always in evidence. He was again transferred to his town stable as the firm considered that he would be better cared for and fed there, but during the next month he made no progress and I advised destruction.

Autopsy revealed miliary tuberculosis of both lungs, with no other visible lesions in the body. The spleen and bones of the neck showed no signs of infection.

This is the third case of equine tuberculosis I have seen during the past two years, although in the other two cases there was also involvement of the spleen and liver, with consequent gastric derangement.

* Case presented to the North of Scotland Division at Aberdeen on 26th March, 1927.

REVIEW.

Principles and Practice of Meat Inspection.

This is the title of a new book, by Dr. Gerald Leighton, which consists of two parts and two appendices. The first part deals with "The General Principles of Meat Inspection" in eleven chapters, *viz.*, General Methods of Inspection, Meat Inspection in the U.S.A., Abattoirs and Slaughter houses, Methods of Slaughtering, General Pathology of Meat Inspection, Meat and its Characters, Comparative Anatomy of Carcases and Organs, The Lymphatic Organs, Parasitology and Bacteriology of Meat Inspection, Judgment and Condemnation.

Part II deals with "Regional and Special Meat Inspection" in ten chapters, which include: Poorness, Emaciation, Emergency Slaughter and Natural Deaths, Tuberculosis in Meat Animals, Diseases of Swine, Diseases of Special Organs and Parts—*e.g.*, muscles, udder, mouth, tongue, pharynx, brain, nervous system, bones and fat—Diseases of the Thorax and Abdomen, Edible Fish, Inspection of fish, game, poultry and canned foods, Inspection in British centres; also Appendix I, which shows the cutting up of meat carcases, and Appendix II, Forms of Records for Abattoirs.

In a Preface the author points to the growing importance of food inspection in general and meat in particular and refers to the work of the Departmental Committees in England and Scotland. From his unique experience, he regards meat inspection as a branch of Comparative Pathology and practices what he preaches by having co-opted medical and veterinary officers engaged in the work both at home and abroad to aid him in his production.

The book contains 120 illustrations, some of which are excellent; others, as have been proved by previous authors, are not suitable by photographic reproduction to make clear the points desired—this can only be done in colour as nearly natural as possible.

The author reiterates what has often been stated by others, *viz.*, that to ensure thorough inspection public abattoirs are necessary, that in Germany those exist in towns with only 2,000 inhabitants; that in Scotland 90 per cent. of all the home killed meat passes through public abattoirs and that Aberdeen, from which much of our choicest beef is derived, still retains private slaughter-houses. The system of inspection in the U.S.A., as described by Ditewig, is quoted as a model, but even in that country 40 per cent. of the meat produced is not subject to Government supervision. The competence of meat inspectors is discussed and the author's well-known views are stated, *viz.*, that only those who have had a training in anatomy, physiology, pathology and bacteriology are qualified to pass judgment on the condition of carcases affected with diseases (even those officers must have given special attention to the subject) and that only specially-trained lay assistant inspectors should be employed as detention officers. In other words, Chief Inspectors should be veterinarians, and assistants should be men who have been trained in the meat trade. Medical men rarely care for this class of work. The methods of inspection are carefully described and by aid of a rather crude diagram of a carcase the positions of the lymph glands (not all) are shown. Very little is given about imported meat, chilled or frozen; this is to be regretted, as 50 per cent. of our meat is imported. No mention is made of the "Temple Cox Captive Bolt" killer, an instrument very successfully used in the City of London experiments.

Although reference is made to the opinions of inspectors in other countries on the subject of caseous lymphadenitis of sheep, no mention is made of the findings in imported carcases in this country which lately formed the subject of an article by a medical and a veterinary officer. We failed to find any reference to actinobacillosis, a condition so often mistaken for actinomycosis.

References to names of some authors' published works should have been quoted by number and at the end of the book, or end of each chapter, or foot of each page, in order that they could be consulted.

The author shows by the whole book that he considers that responsible officers have had pathological and bacteriological training.

The subject matter is written in a manner which shows how broad minded the author is, and that he is desirous of progress and joint action in the realms of comparative pathology. General practitioners and students, not only those in their final year, but for the D.V.S.M., will find this a useful book, and to them we readily recommend it.

The publishers, Messrs. Hodge and Co., of London and Edinburgh, have produced a fine piece of work at a reasonable cost of 25s.

[Principles and Practice of Meat Inspection. Gerald Leighton, O.B.E., M.D., D.Sc., F.R.S.E. Hodge and Co., London and Edinburgh. Price 25s.].

Disinfection of Vehicles Used for Carrying Livestock.

The Transit of Animals Order, of 1927, issued by the Ministry of Agriculture and Fisheries, which will become effective on June 1st next, provides that any owner or user of a vehicle or trailer used for the conveyance of animals shall, after every occasion when the vehicle is so used, and before any other animal or any fodder or litter be placed in it, ensure that the vehicle be cleansed and disinfected. The manner of cleansing and disinfecting, as set out in the Order, is that the floor, roof, and sides of the interior, and the affected parts outside, shall be scraped and swept, and then scrubbed or washed with water, and finally coated or washed with an approved disinfectant.

Every crate, box, hamper, loading board, rope, net, or other apparatus used in connection with such conveyance of animals shall be thoroughly cleansed, and then be coated, washed, or saturated with an approved disinfectant.

Where an inspector considers that an animal intended to be moved by road cannot, owing to old age, infirmity, illness, or for any other cause, be so moved without unnecessary suffering, he may serve a notice to that effect on the person in charge of the animal, prohibiting its removal until such notice is withdrawn.

These new regulations should be carefully noted by readers concerned with the carriage of livestock by road.—*Motor Transport.*

DIVISIONAL REPORTS.

North of Scotland Division.*

The postponed half-yearly meeting of this Division was held in Marischal College, Aberdeen, on Saturday, March 26th, with Mr. James Anderson, Keith, in the Chair.

There were also present Messrs. Brown (Marischal College), Drennan (Aberdeen), MacVean (Craigellachie), Clark (Stonehaven), Cumming (Culter), Howie (County Veterinary Inspector, Aberdeen), Murray (Cullen), Macpherson (Huntly), Beattie (Longside), Murray (Aberdeen), Wallace (Aberdeen), Grant (Aberdeen), Sievwright (Tarland), D. R. Crabb (Strichen), Rice (Montrose) and McAllan (Aberdeen).

Before the commencement of business, Mr. JAMES ANDERSON referred in very sympathetic terms to the sad death of Mr. George Howie, Alford, who, from the commencement of the Division had taken a very keen participation in all its doings and who had been for many years Secretary of the Division. Mr. Anderson referred to the loss of Mr. Howie to the profession as a practitioner, to the Division as its very able and energetic Secretary and to all the members as a friend. Mr. Anderson moved and Mr. MCALLAN seconded, that a message of sympathy be sent to Mrs. Howie and family on their sad loss. This motion was agreed to *sub silentio*.

On the motion of Mr. ANDERSON, seconded by Mr. BROWN, Mr. James MacAllan was appointed Secretary to the meeting.

Apologies for absence were received from Messrs. Hepburn (Aberdeen), W. Anderson (Keith), A. Niven (Inverurie), and D. Crabb (New Aberdour).

ELECTION OF OFFICE BEARERS.

Mr. W. BROWN proposed and Mr. MACVEAN (Craigellachie) seconded, that Mr. J. Anderson (Keith) be appointed President for a second term.

This was unanimously agreed to and Mr. Anderson returned thanks for his re-election.

Mr. ANDERSON proposed and Mr. DRENNAN seconded, that Mr. J. McAllan (Aberdeen) be appointed Secretary.

This was also unanimously agreed to.

CORRESPONDENCE.

The SECRETARY read a letter from the General Secretary of the National Veterinary Medical Association with regard to a resolution passed by the West of Scotland Division characterising the present position of part-time veterinary inspectors under the Milk and Dairies (Scotland) Act of 1914 as unsatisfactory and undignified and urging the Council of the National Veterinary Medical Association to re-open the subject with the Scottish Board of Health with a view to having the restrictions on private practice which are imposed on these inspectors withdrawn. The General Secretary asked for an expression of opinion from the Division to put before the Veterinary Inspectors' Committee of the Council of the National Veterinary Medical Association.

Messrs. ROBSON, CRABB and DRENNAN spoke to the resolution of the West of Scotland Division and each expressed the opinion that no difficulties with regard to the working of the Milk and Dairies (Scotland) Act of 1914 presented themselves as far as that district was concerned.

The meeting was unanimously of opinion that a reply should be sent to the General Secretary that, as far as the Northern District was concerned, the Act had presented no difficulties to the members.

New Member.—Mr. SIEVWRIGHT (Tarland) proposed and Mr. MURRAY (Cullen) seconded, that Mr. Coull (Buckie) be admitted a member. This was unanimously agreed to and Mr. Coull was welcomed by the President.

The PRESIDENT proposed, and Mr. ROBSON seconded, that in future all subscriptions be payable at the 1st of January of each year and not, as had been the habit, some at the August half-yearly meeting and others at the January half-yearly meeting.

The Secretary was also instructed to write to all members who are in arrears with subscriptions.

The next meeting will be held on the last Saturday of August and Mr. Rice (Montrose) kindly promised to give a paper.

Mr. DRENNAN (Aberdeen) then read papers on three interesting cases that he had met with in practice recently. The papers were most excellent and led to a very good discussion. [They are reproduced in the Clinical and Case Reports Section of this issue of the *Record*.—Ed.].

The PRESIDENT congratulated Mr. Drennan on his papers and, with regard to his paper on the Miliary Tuberculosis in the horse, said that he thought it was the common experience to find lesions in the cervical vertebræ and spleen in cases of tuberculosis in the horse. He was not surprised that the ophthalmic test had proved doubtful.

Mr. BROWN (Aberdeen) thought that tuberculosis was perhaps more common in the horse than was generally thought. This he concluded from the evidence of *post-mortem* examinations. Mr. Brown made an appeal to the members for photographs of interesting cases from which he could make lantern slides and he also made requests for pathological specimens which could be mounted and made suitable for exhibition.

Mr. MCALLAN commented on the diagnosis of tuberculosis in the horse and asked Mr. Drennan what tests had been carried out to establish the diagnosis and if any steps had been taken to find out the type of tubercle bacillus in the lesions.

Messrs. MACVEAN, MACPHERSON and WALLACE all commented on the extensive deposit of ingesta in the case of the ruptured œsophagus and the almost entire absence of pleuritic symptoms.

Mr. DRENNAN, in his reply, said that there was no hydrothorax in the case of the ruptured œsophagus, although he was almost unable to believe that it was absent. He said that although there were no lesions of the cervical vetebræ in the case of tuberculosis yet there was a slight loss of power in the neck.

On the motion of the PRESIDENT, seconded by Mr. HOWIE, Mr. Drennan was accorded a very hearty vote of thanks for his very interesting papers.

Mr. BROWN then showed a few lantern slides of interesting cases, just to emphasise the value of photographs in keeping records of cases.

The members then adjourned to Mr. Brown's laboratory, where Mr. BROWN, assisted by Mr. GRANT, demonstrated a most interesting collection of pathological specimens. These led to a very interesting discussion and the thanks of the meeting were conveyed to Mr. Brown and Mr. Grant by the Chairman.

A vote of thanks to the Chairman for his conduct of the meeting concluded a most interesting gathering.

J. MCALLAN,
Hon. Secretary.

* Received on 1st April, 1927.

North of England Division.*

ANNUAL MEETING AT NEWCASTLE-ON-TYNE.

The Annual Meeting of the North of England Division was held in the Armstrong College, Newcastle-on-Tyne, on Saturday, 26th February, 1927.

The programme was a departure from the usual practice, and the success of the gathering completely dispelled any doubt as to the desirability of holding a morning session.

At 11-15 a.m. Mr. W. JACKSON YOUNG gave a short demonstration, illustrated by lantern and microscopic slides, on the Parasite of Sheep Scab.

He gave a lucid description of the causal parasite, *Psoroptes ovis*, that belonged to Phylum Arthropoda, Natural Order Acarina, Family Sarcoptidæ. The chief characteristics of the Psoroptes were, said

* Received on March 18th.

the demonstrator, oval body, pointed beak, four pairs of legs (in adults) visible from above as they projected from the sides of the body. They did not burrow. The tarsus bore a long, three-jointed stalk which was furnished with a sucker on the first, second and third pair of legs in males and on the first, second and fourth pair of legs in females. A lantern slide showing the ovoviviparous stage of the parasite was exhibited.

The life history of the parasite (on which the present policy of double dipping was based) was as follows: The eggs hatch in two to five days. The larvæ moult into nymphæ during the next four days and in another four days the nymphæ moult into adults. The females moult and lay their eggs. The duration of the whole life cycle is from twelve to fourteen days.

It was pointed out that one ovigerous female could give rise to a serious outbreak of sheep scab.

Mr. Young mentioned that he had found tin boxes fitted with glass lids of great convenience for carrying scrapings for examination. The parasites on many occasions would be found adhering to the glass. He reminded the veterinary inspectors present of the necessity for retaining mounted specimens of the parasites on which they based their diagnosis in outbreaks of sheep scab and parasitic mange. The parasites were easily mounted in Farrant's medium and the slides should be suitably labelled and dated.

Operations by Professor Wooldridge.

This was followed by operations on two dogs, performed by Professor G. H. Wooldridge, of the Royal Veterinary College, London.

The first subject was an Alsatian bitch, about five months old, having a large inguinal hernia on the left side. The case was provided by Mr. C. E. Hill, of Darlington. The bitch had received gr.i morphia an hour before operation. When the bitch was placed on the table for operation, the hernia had become reduced and no trace of it could be found, and manipulation of the abdomen in an attempt to reproduce the hernia failed. It was, therefore, necessary to operate in the usual site, picking up the empty hernial sac, as Mr. Hill stated that when the hernia was down it was almost the size of a small fist. Professor Wooldridge explained that under the circumstances the operation was not quite as straightforward, owing to there being rather more difficulty in identifying the empty sac in the inguinal region.

The narcotic action of the morphia was augmented by the administration of a light general anæsthetic consisting of equal parts of chloroform and ether administered by the usual inhaler. After cleansing the part and disinfecting with iodine, incision was made over the inguinal ring and the subcutaneous tissues separated, pushing aside the superficial inguinal lymphatic glands, thus exposing the empty sac with its apex directed backwards under the pubis. It was then picked up with the forceps and separated from the surrounding connective tissue and drawn out. The operator explained that in most cases of inguinal hernia in the bitch the herniated organ was uterus, sometimes accompanied by bowel. In a reducible hernia it might be unnecessary to open the sac at all before ligation. The best procedure in the ordinary way was to reduce the hernia after securing the sac and then twist the sac in such a way that it completely obliterated the channel through the inguinal canal.

A sterile ligature of silk was then placed on the sac as close to the canal as possible and the empty sac cut off about ¼in. below. The stump was then pushed into the abdomen and two sutures of support of No. 1 Chinese silk twist were placed across. The operation wound was then disinfected with a little tincture of iodine and the skin closed with interrupted sutures. The operator pointed out that in some cases it might be desirable, in reducing the hernia and twisting the sac, to open the apex of the sac before ligaturing, in order to sever the attachment of the round ligament of the uterus, which was often present at the apex of the sac, the ligament being then returned with the rest of the viscera before ligaturing. If this was not done, explained Professor Wooldridge, the ligament might slip through the ligature, which then, becoming too loose, would fall off and result in a recurrence of the hernia into the wound. In the particular case being operated upon, however, this procedure was unnecessary.

After-treatment consisted of sponging the operation wound twice daily with a little eusol and maintaining a semi-relaxed condition of the bowels, to prevent straining. A little swelling occurred on the second or third day which was firm but was not associated with any discharge. The operator had explained that a slight swelling might occur in this situation and that he rather preferred it than otherwise, inasmuch as it caused a mechanical closure of the canal, pending the formation of adhesions. The sutures were removed on the seventh day after operation, one having been removed on the fifth, as it showed a little moisture. Otherwise the bitch made an uneventful recovery (the wound apparently healing by first intention) and she scarcely missed a meal from the day of operation.

The second operation was ovaro-hysterectomy on an Airedale bitch, provided by Mr. H. Elphick. The bitch was two or three years' old. She was given gr. iss morphia one hour before operation. The operation site was prepared in the usual way by washing, shaving and disinfecting and the action of the morphia was augmented by the administration of chloroform and ether by inhalation. An incision, about 1½in. long, was made in the middle line. The operator then inserted his finger and, passing it down between the intestines and the abdominal wall, hooked up one uterine horn. This was drawn out and the ovary on that side brought into view. Owing to the size of the bitch and the smallness of the operation wound, a considerable amount of tension was required. A ligature of No. 3 Chinese silk twist was placed above the ovary and artery forceps below it, and the ovary detached between it and the ligature with scissors. The other uterine horn was traced *via* the body of the uterus and was similarly dealt with. The body of the uterus was then drawn into the operation wound, ligatured and removed.

The operation wound was closed with interrupted sutures through the muscle and peritoneum and another row of interrupted sutures through the skin. In this case also the wound healed by first intention and the bitch made an uninterrupted recovery.

In both operations the skin was first disinfected with iodine and during the operations the disinfectant used for sponging was eusol. The instruments, after sterilisation, were placed throughout the operations in 2½ per cent. carbolic acid solution. The ligature materials and sutures throughout were of Chinese silk twist.

During the performance of these operations an attendance of thirty-six was counted.

The Luncheon.

Later, the company adjourned to the University Union Refectory, when the Association welcomed its guests, the Deputy Lord Mayor of Newcastle (Alderman R. H. Millican), who attended in the unavoidable absence of the Lord Mayor (Councillor A. W. Lambert). Sir Theodore Morison (Principal of Armstrong College), Lieut.-Col. J. W. Brittlebank (President of the Royal College of Veterinary Surgeons), Professor G. H. Wooldridge (President N.V.M.A.), Dr. O. Charnock Bradley (Edinburgh), and Professor D. A. Gilchrist (Armstrong College).

Many members were also accompanied by guests, and the number present was forty-six.

In the course of the carrying through of a short toast-list, Major H. Peele submitted "The City of Newcastle-on-Tyne." He alluded to the importance of the veterinary profession connected with public health reform, and said it was very fitting that a representative of the governing body of that city, responsible for the public health, should join them at a function of that sort. There could be no question now that the veterinary surgeon was indispensable in the carrying out of public health duties. He was valuable and was recognised by the State, which was shown in the Government regulations recently issued.

There it was laid down that he was the man properly qualified to inspect cattle and animals which produced food for human consumption. Another reason why they welcomed a representative of the Newcastle Corporation that day was because the Lord Mayor himself had extended an invitation to the "National" Association to hold the Annual Congress next year in that city. (Applause.) They in the North naturally hoped that when the time came the "National" Association would do the right thing and accept it. Tyneside was a great centre and a most appropriate one with regard to facilities; indeed, it was almost unequalled for the holding of such a Congress. He was sure that Sir Theodore Morison would give them the use of those beautiful and commodious buildings of the University, and so help them in every way. Further, people coming from the southern parts of the country would have an exceptional opportunity of viewing that great industrial city and Tyneside generally, including its works, places of historic interest, etc.

The DEPUTY LORD MAYOR (Alderman R. H. Millican), who replied, supported the invitation which had been extended to the National Veterinary Medical Association to hold their Annual Congress in Newcastle-on-Tyne next year. He also outlined the various features of the city and of Tyneside, which provided unrivalled facilities for such a Congress, whether for education, pleasure or profit. He assured the Association that no other city would give them a more cordial welcome for their Congress. Proceeding, the Alderman spoke of the close connection between the Corporation and the University. The city took a great interest in all public institutions of the district. It was of interest to note that Armstrong College received from the City of Newcastle nearly £10,000 per year. That was an item in the estimates of the Corporation which was never questioned or criticised. (Applause.)

Professor D. A. GILCHRIST proposed the toast of "Veterinary Science." Speaking in an historical vein, the Professor said the first Veterinary College, so far as he could trace, was established under Royal patronage in France, at Lyons, in 1761. France, as they all knew, had played an important part in veterinary science and research. The Odiham Agricultural Society, Hampshire, must have been an important body, because he found that it had formed the first Veterinary College in this country—that was in 1791 in London. Proceeding, the Professor said the struggle of veterinary science as well as of agricultural science was to get men who were really good scientists, and at the same time practical. They had that struggle even now. It was because veterinarians had persisted in sticking up for their professional rights, that they had advanced and improved their status during the last twenty years; and greater progress was likely to be experienced in the future. (Applause.)

Lieut.-Col. J. W. BRITTLEBANK, President of the R.C.V.S., in reply, said he was proud of the progress the profession was making, and during the last twenty-five years the progress had been really remarkable. That was a promise of what the next twenty-five or fifty years held for them. The fields which lay absolutely untouched before the veterinarian needed no emphasis from him. They were obvious to most of them. The great field of public health work, to which reference had already been made, was an enormous field in itself. Major Peele had rightly said that no public body to-day felt itself adequately equipped unless it had its veterinary representative. There was another aspect of that huge public health question. They must be careful not to let this work drift into watertight compartments. He felt that the best interests of the public and of the profession would only best be served by the recognition that every practising veterinarian was a public health official. (Applause.) The loss which agriculture had sustained was almost incalculable, but that was a loss which one hoped would diminish. The loss which humanity had sustained by diseases communicated from animal to man was to a large extent unpardonable, and it was full time that a proper service was established throughout the whole country to deal efficiently with many of the problems which were no longer mysteries, as the road along which they should be taken was perfectly open and obvious to all of them. The Royal College of Veterinary Surgeons, Colonel Brittlebank assured his hearers, would keep abreast of all the scientific necessities of the profession. He thought that there was a time when it was supposed generally in the profession that to be a member of the Council of the Royal College of Veterinary Surgeons was a lucrative sort of job—that there was some mysterious gold mine in the precincts of Red Lion Square, in which the members of the Council could delve at their leisure. (Laughter.) Some of them had yet to discover that gold mine. There was another gold mine which some of them felt was all that they required, and that was the satisfaction, the pride of knowing that they had tried to do their best for the profession which they all loved. (Applause.) After a fairly long period of service on the Council, he had never yet seen a single member come there merely to serve his own interests. When they got to Red Lion Square, the interests of the whole profession, and not of a single section only, were theirs. (Applause.) They of the profession had to stand together, or they would never attain the great aims which were in front of them and which were their rights. (Applause.)

Professor G. H. WOOLDRIDGE, President of the N.V.M.A., also acknowledged the toast. He said the invitation by the Lord Mayor of Newcastle, and repeated by the Deputy Lord Mayor, to the National Veterinary Medical Association, to meet in Newcastle next year, had already been received by him, and he had conveyed it to the Council. The invitation had met with a very sympathetic response indeed; but, as many of them knew, the decisions of any particular meeting could only be taken at the annual general meeting, which, however, usually fell in with the advice given to it by the Council. In the meantime, the invitatioh extended to the National Association held pride of place in more senses than one. He was not in a position to commit the Association, but it was certain that the invitation would receive very sympathetic consideration. The Professor assured the gathering that any matter submitted to the National Association would always receive careful attention.

Mr. J. R. RIDER, Darlington, Hon. Secretary of the North of England Division, submitted the toast of "The University of Durham," in a speech of an historical character. He showed the great developments that had taken place locally in the realm of science, and the additional buildings erected for the work within recent years. He trusted that the use of those fine buildings would be given to the Association in the event of the National Congress being held in Newcastle. They all wished the University of Durham continued and ever-increasing prosperity in all its fields of endeavour. (Applause.)

Sir THEODORE MORISON, Principal of Armstrong College, in reply, assured the gathering that when the first suggestion was made to him that they should meet in the College buildings, he welcomed it very warmly, and he was delighted to think that there was good ground for hoping that they would also receive the National Veterinary Medical Association at the College next year. (Applause.) He wished on all occasions that the University and that Association should be as closely allied as possible, and that they should get into the habit of working together; for, after all, they were allies. They were working together in different ways on cognate problems. It was the business of the University to explore the more abstract branches of learning; and it was for those present to master them in the first place, to carry them forward, and then to apply them. They all noticed that a very great change had taken place in recent years with regard to the recognition of the practical value of science; and they could, he thought, ascribe a very large part of the merit of that work to Associations like the N.V.M.A., which, being trained in the principles of science, had gone out to apply it, and show the practical value of it. At one time the comic papers used to caricature the professors going out with their nets, and convey a sense of the uselessness of such a thing. But that work had turned out to be of enormous importance in discovering how to diminish losses in crops and in

reducing insect pests—and now, instead of being laughed at, he received a very high-sounding title and recognition of a more practical nature. (Laughter.) In the Overseas Dominions, as in this country, they were crying out for experts in veterinary science to help in reducing the enormous losses that had taken place. To help in developing the enormous resources of the Dominions it was very necessary to receive the assistance of the veterinarians. (Applause).

Mr. T. M. MITCHELL, of Sunderland, submitted the toast of "Our Guests" in a racy, humorous speech descriptive of the public records and achievements of the principal guests. He remarked that, as yet, there was no faculty for veterinary science at the Armstrong College.

Dr. O. CHARNOCK BRADLEY, of Edinburgh, in reply, was likewise in a humorous mood, and alluded "with a pardonable feeling of envy" to the fact that Newcastle Corporation could give so many thousands of pounds per year on behalf of the Armstrong College.

(To be continued).

THE PROTECTION OF DOGS BILL.

In the House of Commons last week, Sir R. Gower in moving the second reading of the Protection of Dogs Bill, said that it provided that it should be unlawful to perform any experiment of a nature calculated to give pain or disease to any dog for any purpose whatsoever, either with or without anæsthetics, and no person or place should be licensed for the purpose of performing any such experiments. This was not the first time that this Bill had been before the House. On three occasions it had secured a second reading, and on two occasions without a division. Had it not been for an unfortunate accident it would have secured a third reading and been on the Statute Book to-day. The Bill was not brought forward with any desire or intention to obstruct or hamper legitimate surgical or medical research. The general question of the vivisection of animals did not arise, because the Bill applied to one animal only—namely, the dog. He did not think that he would have any difficulty in satisfying the House that the Bill would not impede legitimate scientific research or cause humanity to suffer.

He had carefully studied the literature which had emanated from the Medical Defence Council, and had carefully read the correspondence which had taken place in the lay Press on the subject, and it was most significant that no case, with one exception, had been made out either by members of the public or of the medical profession that it was necessary for humanity that experiments should be made on dogs. That exception was contained in a pamphlet issued by the Medical Research Defence Association. After quoting at some length medical evidence given before the Commission in favour of the exemption of dogs from experiments, Sir R. Gower said that exemption was lost by only a very small majority, so far as the Commission was concerned. In some of the letters which had appeared in the Press doubt had been expressed as to whether, under the safeguards now imposed, animals actually suffered pain under vivisection. He did not think that any hon. member who was a member of the medical profession would dispute that in many cases very great suffering was involved to the unfortunate animal which was the subject of experiment. It was quite clear from the report of the Commission and from the evidence which was given by the Home Office expert that a great deal of suffering was involved. In 1898, Dr. George Watson, in his presidential address to the British Medical Association at Portsmouth, referring to vivisection, said, "I accuse my profession of misleading the public as to the cruelties and horrors which are perpetrated on animal life." If time permitted he could read extracts from the *British Medical Journal* and other papers giving particulars of experiments which had been performed during the last year or so, and which would satisfy the House beyond any question that the unfortunate animals suffered great pain, agony, and misery. What he had said constituted a strong case in support of the exemption of dogs from vivisection and experiments.

Lieut.-Colonel Moore, in seconding the motion, said he was not an anti-vivisectionist. He fully believed that vivisection was necessary for the perfection and extension of human life, but he was not satisfied that dogs, as such, were necessary for the results of those experiments and that vivisection on dogs would naturally result in the saving or the prolongation of human life. There was a growing body of opinion outside that House which resented and looked upon with horror vivisection on dogs and regarded it as a blot on their highly developed civilisation. There was no acceptable proof that experiments on dogs offered any results which could not be obtained from other animals.

Lieut.-Colonel Fremantle, who moved the rejection of the Bill, said it was not possible to answer the case that had been put before the House by the mover and seconder of the Bill in the one-quarter of a minute which remained to him.

The hon. member was still speaking when, under the rules of the House, the debate stood adjourned.

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On the previous day, Lieut.-Colonel Fremantle presented a petition signed by leading members of the medical profession concerned in medical education, including 1,497 medical members of university staffs, medical schools, and teaching hospitals, praying the House not to support any Bill to place further restrictions on experimental work on dogs or other animals, and asking for such an alteration in the existing law as would permit, under proper provisions for the prevention of pain, and efficient inspection and control, the use for purposes of research of some of the numerous stray and unowned dogs.

NOTANDA.

A ready method of producing emesis in the dog is to administer a piece of washing soda of a size from about that of a Barcelona nut to that of a walnut.

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The best way to remove blood stains from clothing is to wash the stain with a weak solution of tartaric acid and then rinse with cold water.

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The incubation periods are, for distemper (canine or feline), three days to three weeks; infectious abortion in cows, 126 days, in mares ten to twenty-one days; anthrax, twelve to twenty-four hours; black quarter, one to five days; foot-and-mouth disease, twelve hours to twelve days; rabies, ten days to six months; strangles, three to eight days; swine fever, five to fifteen days; tetanus in cattle, five to eight days, in horses, four to fifteen or twenty days; canine typhus, three to seven days (?); tuberculosis, two weeks to two months.

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Mares reach puberty in twelve months, cows in twelve months, sheep in eight months, goats eight months; sows, four months; bitches, seven months; cats, eight months. These periods are frequently considerably extended.

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Hexamine, or urotropine, is soluble in water about 1 in 1·5, in alcohol about 1 in 8, but almost insoluble in ether.

H. K.

NOTES AND NEWS.

The Editor will be glad to receive items of professional interest for inclusion in these columns.

Diary of Events.

Sept. 12-17th.—N.V.M.A. Congress at Torquay.

May 9th—Meeting of the Finance Committee, N.V.M.A., at 4 p.m.

Meeting of the Editorial Committee, N.V.M.A., at 4-30 p.m.

May 10th—Meeting of the Midland Counties' Division at Birmingham.

May 18th—Meeting of the West of Scotland Division at Glasgow.

May 25th—Meeting of the Comparative Section of the Royal Society of Medicine, 1 Wimpole St., W.

From our Postbag.

"I think the printing of the *Record* lately a very great improvement—in fact, I heartily congratulate those responsible on the steady advance all round. I hear expressions of keen appreciation from many of my colleagues up here. Keep it up."

The above passage occurs in a letter recently received from a reader on the staff of a Northern University, and is, we are glad to say, typical of many messages of appreciation.

Obituary.

Capt. J. D. Whitehead, F.R.C.V.S., D.V.S.M.

The Veterinary Profession in Lancashire has suffered a grievous loss of one of its most distinguished members by the untimely death of Captain J. D. Whitehead, F.R.C.V.S., D.V.S.M., Veterinary Officer to the City of Salford. He had not been well for some time, but those of us who saw him regularly hoped that his trouble was at an end as there had been a material improvement in his condition during the past few months. Unfortunately, further symptoms appeared, and an operation was decided upon, and he passed away shortly afterwards in the early hours of Sunday, May 1st.

The son of Mr. J. D. Whitehead, of Sale, Cheshire, Captain Whitehead qualified at the Royal (Dick) Veterinary College, Edinburgh, in May, 1902. He was a pupil of the late Major Baird, of Edinburgh, and after qualifying became assistant to Mr. Holroyd, M.R.C.V.S., of Blackburn, for some 18 months or so. He later became an assistant Meat Inspector to the City of Manchester, and in November 1908, was appointed Veterinary Officer to the Borough (now City) of Salford.

Whitehead's work at Salford has been such as those of us who knew him best expected, but he had much to contend with at first. He had ample scope for the exercise of his talents, the cattle market held weekly was perhaps the largest in the country, and from the first he firmly put his foot down on the traffic in diseased and emaciated stock. A sound pathologist and a keen observer, his work in Meat Inspection set a very high standard, and such was his reputation that his decisions were seldom queried. The writer had many opportunities of seeing his work and could not but admire his accuracy and complete mastery of his subject.

His indefatigable devotion to duty during the great foot-and-mouth epidemic, duly appreciated by not only his own Corporation, but also by the Ministry of Agriculture, put a very heavy strain upon his constitution from which it is feared he never recovered, although he never complained.

But he was not only a Meat Inspector, he was a very practical Veterinary Surgeon, who would not disgrace himself in any sphere. An accomplished operator and surgeon of no mean parts, he did an immense amount of hard work during the war when attached to No. 7 Reserve Veterinary Hospital, and later when he proceeded to France. He was later promoted to the rank of Major when he became Commandant of the School of Farriery.

Captain Whitehead took a deep interest in the politics of the profession and had been for many years a member of the Lancashire Veterinary Medical Association, and two years ago filled the chair of President.

He was for many years an examiner in Meat Inspection for the Royal Sanitary Institute, and also lectured on the subject at the Manchester School of Technology, and many of his past students will remember him with affection.

Under a somewhat brusque manner and rather uncompromising exterior, he was a generous and kindly soul who was ever ready to help any deserving case, and was a regular subscriber to the Benevolent Funds of the profession. Those of us who knew him intimately will miss him much and feel that the niche he occupied in our affections will be hard to fill.

The heart-felt sympathy of us all is extended to his sorrowing widow and daughter, and also to his aged parents, in their great loss.

J. W. B.

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Widden, William Francis, late Captain R.A.V.C. Died April 30th, 1927, aged 62 years. Graduated December 14th, 1892 (London).

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"The death took place at Gloucester yesterday," says the *Birmingham Post* of 29th April, "of Mr. George Holtham, M.R.C.V.S., who was well known in the city and county as a veterinary surgeon for many years. He was in his 82nd year, and was at one time a sidesman at St. Nicholas's Church."

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The large number of our readers who, in the course of their business transactions with Messrs. John Bell and Croyden, Ltd., of Wigmore Street, W., had become acquainted with Mr. F. Blaisey, will deeply regret to learn of his death from cancer. Mr. Blaisey had been associated with the firm (previously Arnold and Sons) for 28 years, and was their regular representative at the Congresses of the N.V.M.A.

Erratum.—In Mr. J. W. McIntosh's remarks concerning the Institute of the Horse at the quarterly meeting of Council R.C.V.S., in our issue No. 18, Vol. VII., dated April 30, the words "science of equestration" (page 397, col. ii., para. 4, line 9) should read "science of equitation."

Tuberculosis in Guernsey.

The following is an extract from a letter which recently appeared in *The Times* from Dr. H. D. Bishop, Medical Officer of Health, Guernsey:—

"As regards deaths from tuberculosis in cattle, the policy of immediate slaughter and compensation has been in force here for so many years now that no opinion upon this point can be given. During the past seven years there have been only eight deaths, and during the past three only two from tuberculosis of children under the age of five years. With the extremely low incidence of bovine tuberculosis prevailing in Guernsey, it seems impossible to look upon these striking facts in any other light than of cause and effect."

In the *British Medical Journal*, Dr. Bishop writes: "During the years 1925 and 1926, the number of cattle tuberculin-tested was 1,950; of this number there was one reactor only."

"*Appointment.*—Mr. John Neish Ritchie, M.R.C.V.S., who has been house surgeon at the Royal (Dick) Veterinary College for six months, has," says the *Meat Trades Journal*, "been appointed Assistant Veterinary Inspector for Edinburgh."

The authorised fee payable at the landing place in Great Britain to cover the expenses of veterinary examination in respect of all imported cattle landed, has been reduced from 6d. per head to 5d. per head. The fee for sheep, pigs, and goats will be 1d. per head.

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The Ministry of Agriculture announce the receipt of information from the office of the High Commissioner for the Commonwealth of Australia that the prohibition of the importation into Australia of cattle from Scotland has been removed. The embargo on importation from England and Wales still remains in force.

Cattle from Scotland must either be of genuine Scottish origin or must have been domiciled in Scotland for at least six months prior to shipment. They must go by direct steamer which does not call at any English port after leaving Scotland.

The cattle, it is stated, must be shipped during the period from December to May inclusive, and must be accompanied by certificates and declarations in conformity with Australian quarantine regulations.

R.C.V.S. Library.

The following books have been added to the Library during the past week: Mævers, "Unfruchtbarkeit bei Rindern"; Ostertag, "Tierarztliche Mitwirkung bei der Milchkontrolle"; Boquet et Negre, "Lymphangite Epizootique des Solipedes"; Kraus, "Lyssa bei Mensch und Tier"; Curot, "Galopeurs et Trotteurs"; Medical Research Council, "Reaction of Culture Media"; and Riddell, "Medical Electricity and Radiology."

Books may be borrowed from the Library by Members of the College on payment of postage both ways. Apply to the Librarian, 10 Red Lion Square, London, W.C.1.

Important Notice. The Librarian regrets to report that the following volume has been borrowed from the Library by an unknown borrower and has not been returned:

Notes on the Composition of Scientific Papers: *Albutt.*

If this catches the eye of the member who retains the book, will he please return it at once to the Librarian, 10 Red Lion Square, London, W.C.1.

CORRESPONDENCE.

Letters to the Editor should reach the Office not later than by the first post on Tuesday morning for insertion in following Saturday's issue.

All correspondence must bear the name and address of the contributor for publication.

The Editor does not hold himself responsible for the opinions of his correspondents.

The Benevolent Fund Aid Performance.

To the Editor of The Veterinary Record.

Sir,—At the close of the performance of "The Rotters" I was able to give only an approximate estimate of the amount likely to be handed over to the Victoria Veterinary Benevolent Fund. All monies have now been received and the accounts have been audited, with the result that, owing to the very generous support received on all hands, I have been enabled to hand over the sum of £162 0s. 10d. to the Fund. I shall be grateful if you can find space for the insertion of this letter, and the attached statement of accounts.—Yours truly, P. J. Simpson, F.R.C.V.S.

5 Bank Parade,
West Kensington,
W.14.
April 28th, 1927.

Dramatic Performance in aid of the Victoria Veterinary Benevolent Fund—8th April, 1927.

Statement of Accounts.

Receipts.

	£	s.	d.
Sale of Tickets	88	11	6
Programme Advts.	9	9	0
Donations towards cost of production ...	97	19	0
Sale of Programmes, etc.	17	16	6½
	£213	16	0½

Expenses.

	£	s.	d.
Hire of Hall	6	16	0
Hire of Scenery, etc.	10	15	6
Performing Rights	5	5	0
Printing	9	9	0
Sundries	19	9	8½
Balance handed over to V.V.B. Fund ...	162	0	10
	£213	16	0½

Influenza in the Cat.

To the Editor of The Veterinary Record.

Sir,—In your issue for April 9th Mr. Prime appears to draw some distinction between influenza and distemper of the cat. If the two conditions are not one and the same, I should be greatly interested if Mr. Prime would kindly explain wherein there is a difference. Knowing, as I do, the varieties of feline distemper, there seems no place for any malady which can be called influenza.—Yours truly, Hamilton Kirk.

67 Wigmore Street,
Portman Square, W.1.
3rd May, 1927.

The Editor acknowledges the receipt of the following:—

Communications from Mr. R. L. Higgins, Major H. Kirk, and Mr. W. L. Richardson.